Index Table

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A SEMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

DECEMBER 8, 1970

VOLUME 8 • NUMBER 23

N70-40801 — N70-41800

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Scientific and Technical Aerospace Reports, Volume 8, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Informatics Tisco, Inc.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

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Volume 8 Number 23 / December 8, 1970

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories:

page:

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. 4235

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. 4238

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. 4246

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. 4249

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. 4259

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. 4264

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. 4273

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. 4281

09 ELECTRONIC EQUIPMENT
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 4291

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. 4296

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. 4299

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. 4305

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. 4311

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. 4323

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. 4329

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. 4334

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. 4337

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. 4345

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. 4349

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. 4363

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. 4369

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. 4376

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 4378

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. 4381

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 4382

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 4396

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 4403

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 4404

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. 4406

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 4408

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **4413**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **4415**

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **4423**

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. **4427**

SUBJECT INDEX I-1

PERSONAL AUTHOR INDEX I-63

CORPORATE SOURCE INDEX I-89

CONTRACT NUMBER INDEX I-107

REPORT/ACCESSION NUMBER INDEX I-113

ACCESSION/REPORT NUMBER INDEX I-125

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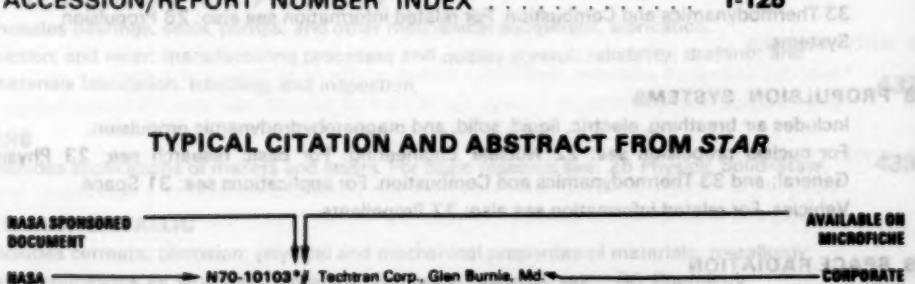
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E. Schwantes Washington NASA Oct. 1969 28 p refs Transl. into ENGLISH from the German report
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Scientific and Technical Aerospace Reports

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Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N70-40470# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

A METHOD FOR GUIDING EFFLUX AIR FROM A FAN-IN-WING MODEL INTO A DISCHARGE DUCT

U. W. Schaub and R. J. Rimmer Feb. 1970 15 p ref

(NRC-11446; MET-508) Avail: NTIS

A scheme is described by means of which the 12-inch fan-in-wing model in the Engine Laboratory was separated from a mechanically connected efflux-removing duct. The modifications that were introduced included a slotted bellmouth inlet, which served as a catch-flow entrance below the air gap, and a diffuser at the exit of the ducting system, which corrected the static pressure level in the duct for transmission of the full efflux flow. The modifications were intended to facilitate mechanical isolation of the model so that direct lift measurements could be made while the efflux air was removed with essentially zero ground effect. Author

N70-40556 Oklahoma Univ., Norman.

TURBULENT BOUNDARY LAYER CHARACTERISTICS OF FLOW OVER A COMPLIANT SURFACE

Robert Raymond Walters (Ph.D. Thesis) 1969 129 p

Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-18468

A detailed hot-wire anemometer study was made to determine the basic characteristics of the turbulent boundary layer flow with a zero pressure gradient over a compliant surface. The compliant surface was constructed from a 0.001 inch polyvinyl-chloride membrane backed by a 3/16 inch damping layer of polyurethane foam. The tests were run at a constant velocity of 50 feet per second. The hot-wire anemometer study over the compliant surface revealed little change in the velocity profile, however a reduction of turbulence intensities was recorded as well as a 25 percent decrease in the Reynolds stresses when compared with hard plate data. The spectra of turbulence measurements indicated a decrease in energy at the higher frequencies throughout the boundary layer. Production, dissipation, and convection of turbulent energy were found to decrease over the compliant surface when compared with the hard plate measurements. Dissert. Abstr.

N70-40825*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A DIRECT MEASUREMENT OF THE MOST PROBABLE PREFERRED ANGULAR VELOCITY OF TURBULENT STRUCTURES BY OPTICAL CORRELATION OF LASER SCHLIEREN SIGNALS

B. H. Funk Washington Oct. 1970 29 p refs

(NASA-TN-D-8 29; M/64) Avail: NTIS CSCL 20D

A method is presented which potentially provides the means for separating the translational and rotational motion of turbulent structures. Simple two-dimensional models are used to relate the skewness of cross-correlograms computed from laser Schlieren signals to the rotation of flow disturbances. The method, referred to as the method of forced similarity, is discussed with respect to application to the turbulent free shear layer of an axisymmetric supersonic jet. Experimental results show that the shape of the cross-correlogram in the neighborhood of the peak is strongly influenced by rotational motion, and it becomes necessary to account for the effect to determine the correct statistical properties of the turbulence. Author

N70-40688*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SPEED WIND-TUNNEL INVESTIGATION OF ALL-FLEXIBLE TWIN-KEEL TENSION-STRUCTURE PARAWINGS

Paul G. Fournier Washington Oct. 1970 85 p refs

(NASA-TN-D-5985; L-7035) Avail: NTIS CSCL 01C

Low-speed wind-tunnel tests were made to determine the static aerodynamic characteristics of several tension-structure all-flexible twin-keel parawings having keel cant angles from 0 deg to 20 deg. Of the configurations tested, those having 5 deg to 15 deg canted keels showed higher values of lift-drag ratio throughout most of the resultant-force range, especially at the higher values of resultant-force coefficient. The overall performance of the basic model was not improved by the addition of either a lower surface scoop or keel mounted upper surface ram-air-inflated tubes. Narrowing the center panel of the basic model did not change the overall performance, whereas widening the center panel resulted in somewhat lower performance. Limited increase in keel-to-payload separation distance resulted in improved performance. Author

N70-40751*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND TUNNEL STUDIES OF EFFECTS OF CONSTRUCTION METHODS, DESIGN DETAILS, AND CANOPY SLOTS ON THE AERODYNAMIC CHARACTERISTICS OF SMALL-SCALE ALL-FLEXIBLE PARAWINGS

Paul G. Fournier and William C. Sleeman, Jr. Washington Oct. 1970 92 p

(NASA-TN-D-5974; L-7013) Avail: NTIS CSCL 01C

A low-speed wind-tunnel investigation was conducted to determine the effects of canopy construction methods, design details, and canopy slots on the static longitudinal aerodynamic

characteristics of all-flexible parawings. Construction details such as type of nonporous canopy fabric, glued or sewed seams, tape reinforcement, or cloth-weave orientation had little effect on maximum lift-drag ratios and resultant-force coefficients. The maximum lift-drag ratios varied from 2.2 to 2.5 for the various single-keel unslotted parawings, and from 2.2 to 2.4 for the slotted canopy parawings. Incremental reductions in the lengths of all the suspension lines caused corresponding reductions in the resultant-force coefficients and maximum lift-drag ratios. The available range for modulation of resultant-force coefficient and lift-drag ratio by shortening the control lines was very limited. Author

N70-40993# Aeronautical Research Council (Gt. Brit.)
THE DESIGN OF COMPRESSION SURFACES FOR HIGH SUPERSONIC SPEEDS USING CONICAL FLOW FIELDS
J. G. Jones and B. A. Woods 1968 25 p refs
(ARC-R/M-3539) Avail: HMSO 11s 6d; BIS $2.30

A method is presented for designing the lower surface of a lifting configuration for high supersonic speeds using the known flow field behind an axisymmetrical conical shock wave. The leading edge can be prescribed on the conical shock wave and the lower surface is obtained by replacing the stream surface through this leading edge by a solid surface. Provided that the upper surface is so designed as not to cause shock detachment, the resulting configuration supports a conical shock wave attached at its swept leading edge, with a known flow field between the shock and the lower surface. Formulas for the calculation of the forces on such surfaces are also given. Author

N70-41033# TRW Systems Group, Redondo Beach, Calif.
ION PROFILES IN COMPRESSIBLE AXISYMMETRIC TURBULENT BOUNDARY LAYERS
Robert L. Chapkis Apr. 1970 24 p refs Prepared for Bell Telephone Labs., Inc., Whippany, N.J.
(TRW-06488-6401-R0-00) Avail: NTIS

Velocity and ion profiles were computed by a numerical finite-difference scheme for the chemically-frozen turbulent boundary layer about a constant-pressure body of revolution. The computations were based on an eddy diffusivity model. The boundary layer edge conditions were taken to be as follows: the edge Mach number M sub e was equal to 11.8, and the ratio of wall temperature to edge temperature T sub w/T sub e was equal to 2.0. Both ablating and nonablating cases were considered. As a test of the numerical scheme and the computer program, computations were also made for cases for which experimental data are available. The agreement between the computations and the experimental data was very good. One result that emerged from the computations is that the gradient of the normalized ion concentration at the body surface is roughly equal to the gradient of the normalized velocity at the body surface. Author

N70-41286# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
AIRFOILS IN TWO-DIMENSIONAL NONUNIFORMLY SHEARED SLIPSTREAMS Final Report, Jun. 1967 – Jun. 1970
Gary R. Ludwig and John C. Erickson, Jr. Jul. 1970 21 p refs
(Contract DAHC04-67-C0071)
(AD-709696; CAL-AC-2489-S-1; AROD-7082-1-E) Avail: NTIS CSCL 1/3

A theoretical and experimental program was conducted to investigate the aerodynamics of an airfoil in a two-dimensional nonuniformly sheared slipstream. A mathematical model was developed to predict airfoil pressure distributions in such a slipstream and was used successfully for slipstreams with moderate shear. Pressure distributions over a wide angle of attack range were measured experimentally on an airfoil at each of seven different locations in a highly sheared two-dimensional slipstream. Study of the pressure distributions obtained on the airfoil at a location slightly above the flow centerline and also at a location slightly below the flow centerline indicates that the large effects on stalling characteristics are due to differences in the upper surface pressure distributions. These pressure distributions are affected by the freestream shear. Moreover, in the data obtained for airfoils located near the flow centerline, the differences in the lift appear to be caused primarily by differences in the stagnation pressure of the streamline which intersects the airfoil. This stagnation pressure is a function not only of airfoil location relative to the slipstream, but also of the angle of attack of the airfoil. Author (TAB)

N70-41283*# Illinois Univ., Urbana.
A STUDY OF THE LOCAL PRESSURE FIELD IN TURBULENT SHEAR FLOW AND ITS RELATION TO AERODYNAMIC NOISE GENERATION Semiannual Status Report, 1 Feb. – 31 Jul. 1970
Barclay G. Jones and Bruce W. Spencer 31 Jul. 1970 32 p refs
(Grant NGR-14-005-149)
(NASA-CR-113881; SASR-1) Avail: NTIS CSCL 20D

Noise generation by turbulent aerodynamic shear flow was studied in the context suggested by Ribner's dilatation formulation for jet noise. The fluctuating fluid field is comprised of a pseudosound pressure field, responsible for generating sound, and a true acoustic pressure field, responsible for its propagation. The pseudosound pressure is a fluid mechanics phenomenon resulting from fluctuating inertial forces within the turbulent flow. Its behavior encompasses the mechanism by which the sound is produced, and the study of this phenomenon is thereby fundamental in understanding and subsequently controlling noise emission from jets. The fluctuating pressure was studied by means of a miniature bleed-type pressure transducer for turbulence measurements. This unique device permits pursuance of the dilatation concept on a laboratory scale basis. Initial phases of the investigation include detailed measurements of the Eulerian and Lagrangian frame velocity and pressure characteristics in a turbulent shear flow. Author

N70-41316# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
THE ROTOR TIP CLEARANCE EFFECT ON THE EXHAUST VELOCITY FIELD OF A ROTATING AXIAL FLOW CASCADE [UEBER DEN EINFLUSS DES LAUFRADSPALTES AUF DAS GESCHWINDIGKEITSFELD AM AUSTRITT EINES ROTIERENDEN, AXIALDURCHSTROEMTEN SCHAUFELGITTERS]
Hartwin Ufer (Ph.D. Thesis) 1968 169 p refs In GERMAN
Avail: NTIS

The hot wire method is used to measure velocity distributions directly at rotor blade tips as well as inside the twisted blades and to determine the flow characteristics at the tip of the blades. It is shown that tip clearance flow effects flow patterns at the blade tips as well as indirectly also the flow down to the fan hub. A comparison of flow characteristics with experimental results on fixed cascades establishes good agreement between observed flow patterns and the investigated rotating flow pattern cascades. Transl. by G.G.

N70-41350# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
THE CALCULATION OF LAMINAR DISSOCIATED HYPERVELOCITY BOUNDARY LAYERS WITH INTEGRAL CONDITIONS [DIE BERECHNUNG LAMINARER DISSOZIIERTER HYPERSCHALLGRENZSCHICHTEN MIT INTEGRALBEDINGUNGEN]
Michael Jischa (Ph.D. Thesis) 1968 100 p refs In GERMAN
Avail: NTIS

An integral method based on impulse and energy laws is used to calculate two-dimensional laminar dissociated hypervelocity boundary layers with and without heat transfer but in thermodynamic equilibrium. A correlation between enthalpy and

velocity fields is used to represent all flow values as functions of the velocity field and the given values. This procedure is applied in example calculations on plate flow, stagnation point flow, and the flow around a semi-spherical cylinder. Dissociation effects on friction values of the flat plate as well as on heat transfer in the stagnation point are discussed in detail. Transl. by G.G.

N70-41375*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
GAS-SURFACE INTERACTIONS AND ORBITAL AERODYNAMIC CALCULATIONS Final Report
Chien Fan and J. W. Warr Apr. 1970 167 p refs
(Contract NAS8-24401)
(NASA-CR-102827; LMSC/HREC-D162228; HREC-4401-2) Avail: NTIS

The findings of a literature survey of experimental and theoretical studies on gas-surface interactions are presented. The experimental studies include the following: (1) laboratory techniques used in producing molecular beams for gas-surface studies; (2) observed molecular scattering phenomena; and (3) determination of momentum and energy accommodation coefficients. The theoretical studies include both analytical and numerical calculations of molecular scattering and accommodation coefficients. Particular attention and emphasis have been paid to those gas-surface interaction studies which have beam energies corresponding to earth orbital flight speeds. A computer program is presented that was developed to calculate force, moment, and heat transfer coefficients for simple and complex vehicle configurations in a variety of orbital environments. Details of the inputs and outputs of the program are described and sample problems are given to illustrate the handling procedure of the program. Author

N70-41476# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium). Turbomachinery Lab.
BLUNT TRADING EDGE BLADING STUDIES IN LOW AND HIGH SPEED FLOWS Interim Scientific Report, 1 Apr. 1969 – 31 Mar. 1970
J. Chauvin, F. Breugelmans, H. Griepentrog, and H. Rottiers 31 Mar. 1970 55 p refs
(Contract F61052-69-C-0025)
(AD-709472; VKI-TN-35; ARL-70-0134) Avail: NTIS CSCL 13/7

The report covers first cascade calculations and testing on blunt trailing edge blades in the subsonic range. First, improvement on a potential flow method is described, and the results of calculations are compared with cascade tunnel data. Fair agreement is obtained. A boundary layer correction was also applied with moderate success. Exploratory studies of the dump diffusion region are reported. Application of the blunt trailing edge blade concept to the low Re number range is then discussed, and the first experimental data bearing on pitch chord ratio optimization are reported. Finally, the essential features of two supersonic compressor stages are discussed. Author (TAB)

N70-41586# Princeton Univ., N.J. Gas Dynamics Lab.
RESEARCH ON HYPERSONIC FLOWS Final Report, Sep. 1966 – Sep. 1969
Seymour M. Bogdonoff Wright-Patterson AFB, Ohio ARL Jan. 1970 38 p refs
(Contract F33615-67-C-1065)
(AD-709216; ARL-70-0015) Avail: NTIS CSCL 20/4

The research, both theoretical and experimental, was centered around three basic areas: (a) hypersonic flows, both inviscid and viscous, (b) hypersonic low density flows extending from classical boundary layer problems at low Reynolds number to conditions where the flow may no longer be considered continuum and including ionized gas problems, and (c) studies of separated flows which included details of the separation and reattachment phenomena over a wide range of Mach and Reynolds number. For the major studies which have been completed and published, brief resumes are presented detailing the important results. For the studies which are still in progress or completed only in the preliminary phases, the results obtained thus far and plans for continuation are presented. Author (TAB)

N70-41721# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
AERODYNAMIC TESTING ON CONICAL CONFIGURATIONS USING A MAGNETIC SUSPENSION SYSTEM Final Report, 1 Jun. – 30 Oct. 1969
Milan Vlajinac and George D. Gilliam Wright-Patterson AFB, Ohio ARL Apr. 1970 81 p refs
(Contract AF 33(615)-1470)
(AD-709197; TR-162; ARL-70-0067) Avail: NTIS CSCL 14/2

Tests were conducted to obtain the pitch plane static force and moment coefficients on conical models at subsonic speeds using a prototype magnetic suspension system. Similar tests were also conducted on a 10 deg. half angle cone at Mach 4.25. The static data obtained are presented and were conducted to obtain the damping in pitch coefficients at both subsonic and supersonic speeds. Although the results of these tests were inconclusive, a discussion of the technique used and recommendations for future testing are presented. Author (TAB)

N70-41732# General Dynamics/ Convair, San Diego, Calif.
FLOW OVER AIRFOILS IN THE TRANSONIC REGIME. VOLUME 1: PREDICTION OF BUFFET ONSET Final Technical Report, 15 Nov. 1968 – 12 Dec. 1969
Richard Magnus and Hideo Yoshihara 1 Mar. 1970 58 p refs
(Contract F33615-69-C-1180)
(AD-709377; AFFDL-TR-70-16-Vol-1) Avail: NTIS CSCL 1/3

The report is concerned with the calculations of the viscous supercritical flow over planar airfoils, and in particular with the prediction of buffet onset using as a criterion the pressure divergence at the trailing edge. To determine the above flow an iterative procedure is considered in which the initial approximation is obtained by quasi-decoupling the boundary layer flow from the outer inviscid flow. The steady inviscid flow is then calculated by an unsteady finite difference method, in which the desired steady flow is obtained as the asymptotic flow at large times. The inviscid procedure is then applied to two examples with satisfactory results. For the treatment of the boundary layer, the initial laminar portion, and the transition zone are calculated in a conventional way, and an integral procedure based upon the continuity and streamwise momentum equations is suggested for the turbulent portion, containing the shock-induced separation, and for the wake, in which specific empirical input is required. Author (TAB)

N70-41733# General Dynamics/ Convair, San Diego, Calif.
FLOW OVER AIRFOILS IN THE TRANSONIC REGIME. VOLUME 2: COMPUTER PROGRAMS Final Report, 15 Nov. 1968 – 12 Dec. 1969
Richard J. Magnus and William H. Gallaher 1 Mar. 1970 362 p refs
(Contract F33615-69-C-1180)
(AD-709378; AFFDL-TR-70-16-Vol-2) Avail: NTIS CSCL 1/3

Digital computer programs for solving two problems are described. The first is for calculating planar inviscid transonic flow over an airfoil by a finite difference method and the second is for calculating the boundary layer on an airfoil for an arbitrary surface velocity distribution by an integral method. The report contains descriptions of the programs and subroutines, program listings and flow charts, and discussion of some of the program features. Author (TAB)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N70-40542# Analytic Services, Inc., Falls Church, Va.
THE WASHINGTON-BALTIMORE REGIONAL AIR FREIGHT TRANSPORT SYSTEM
D. H. Reeher and James W. Dwyer Mar. 1970 140 p refs
(AD-708623) Avail: NTIS CSCL 1/5

The report examines the structure and operation of, and the air freight flows within, the domestic air freight transport system that centers on the airport complex composed of Washington National, Dulles International, and Friendship International airports. It discusses the regional role of each of the three airports, their interactions, and important operational and service activities of associated air and ground links. The report also examines prominent factors that either constrain or facilitate operation of the system. Author (TAB)

N70-40562# National Aerospace Lab., Tokyo (Japan). V/STO Div.
WIND TUNNEL INVESTIGATIONS OF THE STOL AIRPLANE, WITH ATTENTION TO THE RELATIONS BETWEEN THE AERODYNAMIC CHARACTERISTICS AND THE WAKE STRUCTURE
Norio Inumaru, Kiyomi Kitamura, Nagakatsu Kawahata, Hitoshi Takahashi, and Tomoaki Suzuki May 1970 32 p refs
(NAL-TR-197T) Avail: NTIS

Wind tunnel measurements were carried out extensively on the flow field behind a powered model of the twin-propeller deflected slipstream STOL airplane. By the use of new equipments in the measurement, spacial distributions of the flow velocity, down wash angle and side wash angle were obtained. Consequently the extraordinary deformation of the slipstream boundaries, and also the complicated movements of wake vortex systems have been recognized in the flow field. Furthermore by changing the direction of the propeller rotation, marked influences of the rotating flow on the flow field have been exhibited. These observed experimental facts seem to have some connection with the nonlinear aerodynamic characteristics of such a type of STOL airplane. The aerodynamic forces and moments of the model have also been obtained by the use of a sting type balance. The probable relations among the relevant facts are discussed. Author

N70-40594# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
PROPELLER STATIC PERFORMANCE TESTS FOR V/STOL AIRCRAFT. PART 2: TEST DATA, APPENDIX 3, REPORT FOR JULY 1965 – NOVEMBER 1967
Matthew H. Chopin Jan. 1970 366 p
(AD-708742; ASD-TR-69-15-Pt-2-App-3) Avail: NTIS CSCL 1/3

The report presents the reduced data obtained during an extensive series of propeller static performance tests which were run because of a static performance thrust deficiency encountered during flight tests of the XC-142A V/STOL Cargo Aircraft. Thirteen different propellers were used; 28 different configurations were obtained by changing parameters of some of the 13 blades. The reduced data for the 28 versions of propellers tested are presented. Parameters studied during the tests included blade cuff (on or off), tip shape, twist, activity factor, camber, and airfoil section. Data on several other static thrust propellers tested on Rigs Nos. 1 and 4, which were not a part of this test series, are also presented for additional information. The information obtained from the tests, in effect, represents a state-of-the-art study for improving propeller static performance for V/STOL aircraft applications. The information obtained during these tests can be used to more accurately predict static thrust for future propeller driven V/STOL aircraft. Author (TAB)

N70-40628# School of Aerospace Medicine, Brooks AFB, Tex.
NOISE ENVIRONMENTS WITHIN MULTIPLACE FIXED WING AIRCRAFT Final Report, Jul. 1965 – Dec. 1969
Donald C. Gasaway May 1970 23 p refs
(AD-708430; SAM-TR-70-26) Avail: NTIS CSCL 20/1

Noise environments within various multiplace fixed-wing aircraft demonstrate differences related to the proximity of the occupant to primary and secondary noise-generating mechanisms. The report defines acoustic environments sampled at different locations within eight groups of fixed-wing aircraft during conditions of normal cruise. A total of 51 aircraft, representative of vehicles powered by reciprocating, turbopropeller, and turbojet or turbofan engines, provided the data from which 28 noise envelopes were plotted. Author (TAB)

N70-40657*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPIN-TUNNEL INVESTIGATION OF A 1/20 SCALE MODEL OF A MODIFIED STRAIGHT-WING, TWIN-BOOM, COUNTER-INSURGENCY AIRPLANE
Henry A. Lee Washington Oct. 1970 23 p refs
(NASA-TM-X-2053; L-7142) Avail: NTIS CSCL 01C

The test results indicate that the airplane will spin in the erect attitude for all loading conditions and will spin inverted only for ailerons-with control settings. The optimum control technique for recovery from all spins is movement of the rudder to against the spin followed about one-half turn later by neutralization of the longitudinal and lateral controls. Satisfactory emergency recoveries from spins can be obtained by the use of rockets that produce an antispin yawing moment (about the Z body axis) of at least 27,600 ft-lb for at least 4.5 seconds. Author

N70-40667*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MODEL WIND-TUNNEL AND FLIGHT INVESTIGATION OF A PARAWING LIFTING BODY LANDING SYSTEM
Rodger L. Naeseth Washington Oct. 1970 91 p refs
(NASA-TN-D-5893; L-6995) Avail: NTIS CSCL 01C

A parawing has been used with a model hypersonic lifting body, and landing and maneuvering capability which would be needed for the landing phase of the reentry trajectory was demonstrated. Small-scale wind tunnel and flight test results were used in designing the rigging and controls for an instrumented flight test model (70 in. long). The wind tunnel tests were made in the 17-foot test section of the Langley 300-MPH 7- by 10-foot tunnel and the flight tests were made at the NASA Wallops Station. Results of the tests showed that the rigging tightly coupled the body to the parawing so that little or no relative motion between wing and body occurred even in sharp turns. Lateral control by means of the parawing tip lines could produce turn rates of 25 deg per second and longitudinal control by means of the aft keel line could modulate the model in pitch from nose tuck (low angle of attack) to stall. The model was tested in a fully developed stall and was found to recover satisfactorily. Landing on the rounded bottom of the body was not satisfactory, at least in model size. Operations and safety procedures developed during the flight tests are described. Author

N70-40689*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A TWIN-TURBOFAN SUBSONIC TRANSPORT WITH NACELLES MOUNTED UNDER THE WINGS

Francis J. Capone Washington Oct. 1970 94 p refs (NASA-TN-D-5971; L-7141) Avail: NTIS CSCL 01C

An investigation has been conducted in the Langley 16-foot transonic tunnel to determine the longitudinal aerodynamic characteristics of a 0.062-scale, twin-turbofan subsonic transport at Mach numbers from 0.55 to 0.85 and angles of attack from about −2 deg to 6 deg. The Reynolds number based on wing mean aerodynamic chord varied from 0.00000225 to 0.00000270. The effects of model-component buildup, horizontal-tail effectiveness, boundary-layer transition, and wing and nacelle modifications were measured. The model was mounted by using a sting-strut arrangement with the strut entering the model through the underside of the fuselage approximately 65 percent of the fuselage length rearward of the model nose. Strut-interference effects were measured and applied as a correction to the data. Author

N70-40690*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

GROUND-EFFECTS INVESTIGATION OF A STOL AIR-SEA TRANSPORT MODEL WITH BLOWING OVER THE CANARD AND WING FLAPS

Raymond D. Vogler Washington Oct. 1970 44 p refs (NASA-TN-D-5988; L-7193) Avail: NTIS CSCL 01C

Compressed air was used for blowing over the flaps of the canard and wing. The total mass flow over the flaps was varied as well as the distribution of the flow between the canard and wing. Data were obtained through an angle-of-attack range and an angle-of-sideslip range with the model at various heights above a moving ground plane. Interference effects between canard and wing were obtained by comparing complete model data with data for the wing alone and canard alone. Author

N70-40701# Advisory Group for Aerospace Research and Development, Paris (France).

PRELIMINARY DESIGN ASPECTS OF MILITARY AIRCRAFT

Mar. 1970 303 p refs Presented at 35th Meeting of the Flight Mech. Panel of AGARD, The Hague, 2–5 Sep. 1969 (AGARD-CP-62) Avail: NTIS

The aspects discussed included project design, aerodynamics, power plants, structures, airframe systems, and operational systems and requirements. For individual titles, see N70-40702 through N70-40720.

N70-40702# Advisory Group for Aerospace Research and Development, Paris (France).

INTRODUCTORY REMARKS ON PRELIMINARY AIRPLANE DESIGN

Clem C. Weissman *In its* Prelim. Design Aspects of Mil. Aircraft Mar. 1970 5 p (See N70-40701 23-02) Avail: NTIS

Following a brief discussion of the mission of AGARD, it is stated that the object of the symposium is to highlight the methods and techniques of preliminary airplane design and to explore those compromises involved in the early design stage. The stages usually found in a development program are outlined. Feasibility studies concerning a generalized requirement are undertaken to investigate the various possible technical solutions, together with indications of timescale and cost. An initial study of the relative cost effectiveness of alternative proposals may be determined. A firm requirement may then be produced, which is the technical solution chosen from the feasibility study. Project studies are subsequently carried out against the full requirement; from these, a complete aircraft specification with detailed performance, development, and production time scales and costs is drawn up. Thus, the major compromises and decisions are made prior to the design go-ahead. P.A.B.

N70-40703# British Aircraft Corp., Preston (England).

PROJECT DESIGN OF COMBAT AIRCRAFT

B. O. Heath *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 25 p (See N70-40701 23-02) Avail: NTIS

The traditional role of establishing a datum aircraft configuration is covered as one part of a project design process which as a whole must ensure margins and tolerances acceptable to both contractor and procurement agency. Organizational aspects, parametric studies, layout considerations, overall design synthesis examples, systems, and structure are discussed. It is stated that project design is a process which draws upon past experience and upon the advice of specialists in order to obtain the best balance of performance in all its aspects, costs, and timescale. P.A.B.

N70-40704# Dassault (Marcel) Aeronautique-Electronique, Vaucresson (France).

ARMY AIRCRAFT: PROGRAMS AND REALIZATIONS [AVIONS D'ARME: PROGRAMMES ET REALISATIONS]

H. Deplante *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 7 p In FRENCH (See N70-40701 23-02) Avail: NTIS

The selection and development of aircraft apparatus (engines, airframes, equipment, or armament) over the last twenty years is discussed, including the cooperation between the official services and the constructors, the responsibilities of each, and development programs generated. Interactions between the state and the constructors are examined, and the influence of competition and the challenge for survival noted. The creation of Dassault prototypes is reviewed in this context. Transl. by P.A.B.

N70-40705# Messerschmitt-Boelkow G.m.b.H., Munich (West Germany).

THE USE OF TRADE-OFF STUDIES IN PRELIMINARY DESIGN

Helmut Langfelder *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 12 p (See N70-40701 23-02) Avail: NTIS

The technique of balanced effectiveness studies is illustrated by a discussion of such questions as wing and thrust loading choices, sizing, speed capability, number of engines, aerodynamic configuration, aircraft subsystems, automatic checkout, and electronic system complexity, as seen in relation to weight and cost penalties. It is concluded that tradeoff studies on a wide range of parameters are the only means of rationalizing basic design decisions. Author

N70-40706# Boeing Co., Seattle, Wash.

AEROELASTIC CONSTRAINTS FOR LARGE AIRPLANES WITH A CANARD CONTROL

William T. Hamilton *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 11 p (See N70-40701 23-02) Avail: NTIS

Preliminary design studies were made of a large, supersonic, transport, variable sweep airplane with a canard pitch control. The combined effects of the rigid aircraft aerodynamics and aeroelasticity; the size, location, planform, and elastic characteristics of the canard control; and the interacting effects of wing, fuselage, and mass distribution are among the design considerations. P.A.B.

N70-40707# Royal Aircraft Establishment, Farnborough (England).
SOME FLUID-DYNAMICS CONSIDERATIONS RELATING TO THE PRELIMINARY DESIGN OF COMBAT AIRCRAFT
John Williams and Robert K. Page *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 14 p refs (See N70-40701 23-02)
Avail: NTIS

Some of the fluid dynamics considerations which arise in the early design stages of advanced combat aircraft are examined. After some performance considerations of this type of aircraft, including comparisons between fixed wing and variable sweep layouts, reference is made to aerodynamic problems in the design of variable sweep aircraft. A brief outline is given of some of the outstanding problems of wing design, wing-body interference, and the estimation of wave drag. Some questions arising in the choice of engine intakes are mentioned, along with the many jet and afterbody problems, including the possible effects of jet temperature on the base drag. Author

N70-40708# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
FUTURE ADVANCES IN THE AERODYNAMICS OF MILITARY STRIKE AIRCRAFT
Richard H. Klepinger, John W. Carlson, and William M. Stout *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 18 p refs (See N70-40701 23-02)
Avail: NTIS

The primary mission requirements of an air superiority fighter are reviewed, and the factors which affect performance and maneuverability are discussed. The aerodynamic features which have a strong influence on fighter capability are indicated. The effect of the rapid development of numerical solution techniques, using the digital computer, on aerodynamic design methods is noted. The current trend toward configurations with minimum basic aerodynamic stability and extensive stability augmentation is discussed. The need for improved aerodynamic stability is emphasized, and some of the current flight problems of supersonic fighter aircraft are described. It is shown that stability augmentation can cause adverse effects in some flight regimes. The analyses and test programs that are essential before an aerodynamic design is committed to production are summarized. Author

N70-40709# Hawker Siddeley Aviation, Ltd., London (England).
DESIGNER'S VIEW OF POWERPLANT PROBLEMS
R. S. Hopper *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 16 p (See N70-40701 23-02)
Avail: NTIS

The problems of installing the powerplant in the airframe are examined, including the overall problem of layout along with the detailed problems arising at the engine/airframe interface, and limited to the jet engine as installed in fighter type aircraft. The development of the jet fighter is briefly traced from the end of the piston engined era, with Hawker Siddeley aircraft used as examples. Engine starting, gyroscopic coupling, foreign object damage, fuel systems, intake design, exhaust design, and powerplant cost are considered, with recommendations for both the airframe and engine designers. P.A.B.

N70-40710# General Electric Co., Cincinnati, Ohio.
THE DESIGN PROCESS
James E. Worsham *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 8 p (See N70-40701 23-02)
Avail: NTIS

The development of a modern multi-mission fighter engine requires a weapon system design approach, with close integration of the engine and aircraft manufacturers, to assure a successful program. Some of the key decision points that are vital to such a program, including the conceptual approach, technology improvement programs, compatibility requirements, final selection of technology, and engine size selection are discussed. The criteria for full program initiation is a total system defined by firm specifications, definitive interface agreements, verified technical approach, and firm schedule and cost. These criteria can be satisfied by the proper system design process. Author

N70-40711# Dassault (Marcel) Aeronautique-Electronique, Vaucresson (France).
THE INTEGRATION OF THE PROPELLER AND THE AIRFRAME ON A SUPERSONIC COMBAT AIRCRAFT [L'INTEGRATION DU PROPULSEUR ET DE LA CELLULE SUR UN AVION DE COMBAT SUPERSONIQUE]
G. de Richemont *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 13 p In FRENCH (See N70-40701 23-02)
Avail: NTIS

The compromises between diverse requirements are studied. Leading ideas and the development process are shown and illustrated by analysis of the conception and evolution of air intakes and afterbodies of Dassault aircraft. Design constraints are also illustrated by examples. In-flight and wind tunnel test methods are presented, as well as tentative principles of correlation with the aid of mathematical models. Transl. by P.A.B.

N70-40712# Advisory Group for Aerospace Research and Development, Paris (France).
DESIGNER'S VIEW ON STRUCTURAL PROBLEMS
Rolf Riccius *In its* Prelim. Design Aspects of Mil. Aircraft Mar. 1970 20 p refs (See N70-40701 23-02)
Avail: NTIS

The aircraft designer has the obligation to analyze carefully the specific requirements and then to present an optimum approach to a weapon system within a reasonable number of iterations. Accurate data are imperative for optimizing the structure, especially in the fields of weight prediction, materials, design research, and production methods. These problems are discussed by means of a number of examples, and development trends are demonstrated. Recommendations are issued concerning in which way and by what means preliminary design, with special attention to structural design, should be improved. Author

N70-40713# British Aircraft Corp., Preston (England).
LOAD ESTIMATION AND AEROELASTICITY IN THE INITIAL STAGES OF ADVANCED COMBAT AIRCRAFT DESIGN
B. J. Beale *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 16 p refs (See N70-40701 23-02)
Avail: NTIS

Within the areas of load estimation and aeroelasticity, the essential needs during the initial design stages of an aircraft are the rapid provision of realistic loading information and the exertion of a favorable aeroelastic influence on the design. These needs are examined in terms of three basic steps, namely, data acquisition, aircraft stability assessment, and response calculations, with special reference to the problems posed by typical advanced combat aircraft configurations and requirements. The design of such aircraft highlights the need for an approach which integrates the various aerodynamic and structural disciplines, with the major problem being the acquisition of aerodynamic data, particularly for loading purposes. Author

N70-40714# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
THE INFLUENCE OF NEW MATERIALS ON AIRCRAFT DESIGN

Richard F. Hoener *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 17 p refs (See N70-40701 23-02)
Avail: NTIS

Currently available materials are reviewed, and their limitations and future potentials discussed. New materials and their application and development programs, which were initiated to validate their design potentials as well as to establish confidence in their structural impact on future military aircraft, are highlighted. It is found that significant potential savings are possible if new metals are utilized to the fullest extent and that revolutionary advances in aircraft design and performance can be made by the utilization of the new advanced filament composite materials. It is also noted that many potential advances have not been made because of low cost effectiveness potential, lack of confidence in the new material, extensive data requirements, the requirement for large capital investment in new machine tools, and the presence of a highly skilled labor force. Finally, the requirements for a better mutual understanding between the technical specialists, which is necessary if these new materials are to be integrated into new military aircraft, are outlined. Author

N70-40715# North American Rockwell Corp., El Segundo, Calif.
AIRFRAME SYSTEMS DESIGN EVALUATION
Lawrence P. Greene *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 13 p (See N70-40701 23-02)
Avail: NTIS

A general view of the compromises a designer must make in aircraft subsystems to achieve the correct and optimum effectiveness of the total aircraft system is presented. The emphasis is directed at resolution of problems relating to flight mechanics functions. It is intended to identify the contribution an imaginative systems designer can make to an effective flying machine, which in turn is recognized to be one of the necessary assets of military aircraft. The essence of any successful design is the understanding the proponents of each associated discipline exercises when dealing with others of the design team. Examples of design ingenuity are shown to illustrate some of the areas where innovation provided reasonable answers to otherwise troublesome problems. General observations of the requirements imposed on supporting airframe systems are developed, with particular attention to control system options, power sources, environmental problems , and total system dependability. Author

N70-40716# Service Technique de l'Air, Paris (France).
ADVANCED STUDIES IN THE FIELD OF FLIGHT CONTROLS [ETUDES AVANCEES DANS LE DOMAINE DES COMMANDES DE VOL]
In AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 35 p In FRENCH Prepared in cooperation with sud-Aviation, Paris (See N70-40701 23-02)
Avail: NTIS

Problems met in the design of modern combat aircraft are discussed, including the increase of the power necessary for activating the control surfaces, variations of stability and controllability characteristics, the introduction of severe perturbations linked, for example, to the Mach number, structural deformations, and safety problems. Some possible solutions to the problems are examined. The system of flight control of the civil supersonic transport aircraft Concorde is then investigated, with reference to performance objectives and objectives of reliability, in the sense of navigability and operational utilization. Application of these objectives to the general design of the system and to its technology is discussed. An electrical system of transmitting the piloting orders, which integrates a plurality of automatic navigation aids, is utilized, which is derived from advanced military aircraft development. Transl. by P.A.B.

N70-40717# Royal Aircraft Establishment, Farnborough (England). Avionics Dept.
ADVANCES IN AIRCRAFT CONTROL SYSTEMS WITH PARTICULAR REFERENCE TO COMBAT AIRCRAFT
G. C. Howell *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 15 p refs (See N70-40701 23-02)
Avail: NTIS

A review of current flight control system design for combat aircraft is given, highlighting the reliance placed on forms of electrical signalling of the flying control surfaces and the increasing use of feedback control techniques to achieve satisfactory handling qualities. In all current systems, however, a mechanical backup system is retained. A description of a possible electrical signalling system design is given, including maneuver demand control characteristics, and some of its advantages are discussed. The conclusion is reached that, although some experience is being gained in service of forms of electrical signaling, aircraft designers have not yet the confidence to eliminate mechanical reversion systems; these often compromise the primary electrical signalling system performance. Recent system developments should lead to the abandoning of these mechanical reversion systems in future project designs and the full benefits of feedback control can then be obtained. These include the optimization of the overall airframe, taking advantage of feedback control, and new cockpit layouts, taking advantage of the use of small side controllers. Author

N70-40718# LTV Aerospace Corp., Dallas, Tex. Vought Aeronautics Div.
THE INTERFACE OF MAINTAINABILITY, RELIABILITY, AND ASSOCIATED DISCIPLINES IN AIRCRAFT DESIGN
S. Love *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 7 p (See N70-40701 23-02)
Avail: NTIS

Techniques for assuring proper reliability, maintainability, human factors, and system safety considerations in the initial design phase are considered. The definition of the problem, development of a prediction capability, and the formulation of these disciplines in such a manner that they are useful in the overall design process are discussed. In each of the four areas, a formal program plan is required; the techniques used to accomplish the program include the translation of general requirements into specifics, design definition inputs, design surveillance, and participation in design reviews and trade studies, as well as the use of mockups and simulator studies. P.A.B.

N70-40719# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Avionics Div.
AVIONICS DESIGNER'S VIEW OF THE SYSTEMS INTEGRATION PROBLEM
Saul Weissman *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 12 p refs (See N70-40701 23-02)
Avail: NTIS

An example is given of the electronic designer's problem in providing an avionics subsystems design which can be suitably integrated into an aeronautical system to satisfy a critical operational requirement, i.e., low level, high speed penetration at a minimum altitude of 300 feet over or around any terrain profile. The required sensors and their capabilities are examined, and the necessary interfaces for accommodation of the aircraft responses and control restraints are considered. The man-machine relationships are described, and air safety required features are delineated. The basic sensor, a forward looking radar with a phased interferometer array and associated receiver, is examined. Flight station display and instrumentation is described. Data of simulated low level flights over a selected terrain profile are shown under various conditions of environment (rain) and radar measurement error parameters. Author

N70-40748# Federal Aviation Administration, Washington D.C. Office of the Associate Administrator for Engineering and Development.

RESEARCH AND DEVELOPMENT PLAN TO INCREASE AIRPORT AND AIRWAY SYSTEM CAPACITY: PROGRAM DESCRIPTION

May 1970 62 p

(AD-707186) Avail: NTIS

The research and development activity described is to achieve the national goal of providing an air transportation system for all categories of aviation commensurate with projected growth of the air transportation industry. This objective requires an accelerated effort to substantially upgrade the existing airport and airway systems by developing and introducing new concepts and technologies which are adpated to the needs while tempered by evolutionary, sociological, and economic factors. Prior studies and experience provide a substantial foundation of understanding requirements and technical opportunities from which this program evolves. The urgency to proceed expeditiously stems from the basic fact that aviation growth is rapidly outpacing the capacity of the existing system. Accordingly, the philosophy of this program is to proceed simultaneously from the outset with hardware development for early implementation based on current knowledge and assumptions, and, concurrently, with system engineering analyses which will refine performance requirements, detail system integration and interface specifications for both the present and next generation systems. Author

N70-40765# Federal Aviation Administration, Washington, D.C. Office of Management Services.

ENROUTE IFR AIR TRAFFIC SURVEY, PEAK DAY, FY 1969

1969 213 p refs

(AD-710762) Avail: NTIS CSCL 17/7

Statistical data on peak day instrument flight rules (IFR) departures from the enroute air traffic facilities operated by the Federal Aviation Administration (FAA) are presented in tabular and graphic form. The peak day for a facility is the day during the fiscal year when the largest number of IFR departures is recorded at the facility. It is not the same date for all facilities. Therefore, national totals, which summarize all individual facility peak day figures, represent IFR departures on a theoretical, rather than on an actual peak day. Author

N70-40776# Federal Aviation Administration, Washington, D.C.

RESEARCH AND DEVELOPMENT REPORT TO INDUSTRY

Jun. 1969 161 p refs

Avail: NTIS

CONTENTS:

1. OPERATIONAL EVALUATION OF STOL AIRCRAFT AND RELATED STOL DEVELOPMENTS J. C. Staples 6 p (See N70-40777 23-02)

2. RUNWAY TRACTION R. C. McGuire 5 p (See N70-40778 23-11)

3. PROPULSION FUEL SYSTEM FIRE SAFETY T. G. Horeff 10 p (See N70-40779 23-02)

4. FLIGHT TESTS OF SPIRAL DIVERGENCE AND BANK ANGLE CONTROL OF EXECUTIVE JETS J. Teplitz 9 p (See N70-40780 23-02)

5. VFR-IFR EXPERIMENTAL TRAINING PROGRAM AND DEVELOPMENT OF IMPROVED METHOD OF ICE PREVENTION AND REMOVAL FOR LIGHT AIRCRAFT G. C. Hay 13 p (See N70-40781 23-02)

6. AEROMEDICAL RESEARCH: THE NEW GENERATION AIRCRAFT S. R. Mohler 18 p refs (See N70-40782 23-02)

7. EXPANSION OF AUTOMATION IN TERMINAL ATC FACILITIES J. C. Mercer 25 p (See N70-40783 23-21)

8. ALL WEATHER LANDING DEVELOPMENT TESTS J. R. Nelson 13 p (See N70-40784 23-21)

9. VISIBILITY MEASUREMENT FOR AVIATION USE E. Bromley, Jr. 15 p refs (See N70-40785 23-21)

10. APPLICATION OF TIME ORDERED TECHNOLOGY TO THE FUTURE NAS P. J. LaRochelle 29 p (See N70-40786 23-21)

11. AIRCRAFT NOISE AND SONIC BOOM RESEARCH AND DEVELOPMENT I. H. Hoover 6 p refs (See N70-40787 23-02)

N70-40777# Federal Aviation Administration, Washington, D.C. Aircraft Development Service.

OPERATIONAL EVALUATION OF STOL AIRCRAFT AND RELATED STOL DEVELOPMENTS

J. Clay Staples *In its* Res. and Develop. Rept. to Ind. Jun. 1969 6 p (See N70-40776 23-02)

Avail: NTIS

The status of several FAA STOL activities are reviewed. Briefly discussed are: (1) STOL operational evaluation at the test facility, Atlantic City; (2) FAA participation in the McDonnell Douglas/Eastern Airlines and the McDonnell Douglas/American Airlines STOL demonstrations; (3) FAA procurement of a steep gradient approach navigation aid; and (4) investigation of STOL handling characteristics. A.L.

N70-40779# Federal Aviation Administration, Washington, D.C. Aircraft Development Service.

PROPULSION FUEL SYSTEM FIRE SAFETY

Thomas G. Horeff *In its* Res. and Develop. Rept. to Ind. Jun. 1969 10 p (See N70-40776 23-02)

Avail: NTIS

Research and development progress on aircraft propulsion fuel system fire safety and prevention is presented. Specifically discussed are: (1) tests of liquid nitrogen as a fire extinguishing agent; (2) flame propagation through aircraft vent systems; and (3) thickened safety fuels and fuel system compatibility. Also discussed is the amount of air pollution caused by aircraft and the limitations it may have on the growth of air transportation if precautions are not taken. A.L.

N70-40780# Federal Aviation Administration, Washington, D.C. Aircraft Development Service.

FLIGHT TESTS OF SPIRAL DIVERGENCE AND BANK ANGLE CONTROL OF EXECUTIVE JETS

Jerome Teplitz *In its* Res. and Develop. Rept. to Ind. Jun. 1969 9 p (See N70-40776 23-02)

Avail: NTIS

Results of an FAA sponsored investigation into the spiral divergence and bank angle control parameters of high performance executive jet aircraft are presented. For this investigation, the three axis variable stability T-33 airplane developed for the Air Force Flight Dynamics Laboratory was used. The test program was established following a comprehensive review and analysis of available data on modern subsonic executive jets. Test variables included: (1) spiral mode time constant; (2) roll-to-sideslip ratio; (3) roll mode time constant; and (4) lateral hysteresis and breakout force. Analysis of the flight test data demonstrates the benefits in handling qualities available from close attention to the aerodynamic and control system design of high speed aircraft. It is also possible for the executive jet or high performance personal aircraft designer to make a realistic estimate of the acceptability of the lateral-directional handling qualities, cruise flight, and the upset/divergence characteristics of a new design, based on relatively simple calculations, other research data, and comparisons with the results of these flight tests. A.L.

N70-40781# Federal Aviation Administration, Washington, D.C. Aircraft Development Service.

VFR-IFR EXPERIMENTAL TRAINING PROGRAM AND

DEVELOPMENT OF IMPROVED METHOD OF ICE PREVENTION AND REMOVAL FOR LIGHT AIRCRAFT
George C. Hay *In its* Res. and Develop. Rept. to Ind. Jun. 1969 13 p (See N70-40776 23-02)
Avail: NTIS

The increased utility of general aviation requires continual consideration of newer and better ways of training pilots and more effective ways of coping with the operating environment. A VFR-IFR experimental training program and development of improved methods of ice prevention and removal for light aircraft were investigated. Results indicate that: (1) Certification of private pilots with instrument ratings requires approximately 120 hours flight time; greater utilization of the current procedure trainers; and structuring of a curriculum into three distinct phases of about 40 hours each. (2) Tests of ice accretion characteristics and release properties of newly developed passive materials did not reveal any test material which permitted the air stream to blow the ice from the wing, however, marked reductions were noted in forces required to release the ice from certain of the treated aluminum surfaces. A.L.

N70-40782# Federal Aviation Administration, Washington, D.C. Aeromedical Applications Div.
AEROMEDICAL RESEARCH: THE NEW GENERATION AIRCRAFT
Stanley R. Mohler *In its* Res. and Develop. Rept. to Ind. Jun. 1969 18 p refs (See N70-40776 23-02)
Avail: NTIS

Aeromedical personnel are providing human tolerance data to design engineers for incorporation in tomorrow's aircraft. Tentative airworthiness standards for SST aircraft continue to be refined as new aeromedical research data is translated into engineering terms. These include cabin decompression, heat, and ozone limits. Studies are also continuing in other areas, including air crew workload considerations, cosmic radiation aspects, and crashworthiness. Author

N70-40787# Federal Aviation Administration, Washington, D.C. Office of Noise Abatement.
AIRCRAFT NOISE AND SONIC BOOM RESEARCH AND DEVELOPMENT
I. H. Hoover *In its* Res. and Develop. Rept. to Ind. Jun. 1969 6 p refs (See N70-40776 23-02)
Avail: NTIS

The Federal Aviation Administration's research and development programs related to sonic booms and abatement of aircraft noise are briefly described by means of several slides. Also included are lists of reports issued on FAA sponsored research on sonic booms and noise abatement. A. L.

N70-40800# Federal Aviation Administration, Washington, D.C. Information and Statistics Div.
THE 1970 STUDY OF GENERAL AVIATION FLYING OCCUPANT LOAD FACTORS. BASED UPON ACCIDENT RECORDS FOR GENERAL AVIATION FLYING 1964–1968
Jay L. Zebooker May 1970 50 p
(Rept-70-9) Avail: NTIS

Content of the general aviation accident data system was analyzed to derive occupant load factors. Their applicability to all general aviation flying is substantiated. It is estimated that there were 2.5 persons on the average general aviation flight. Author

N70-40911# Federal Aviation Administration, Washington, D.C.
COMPILATION OF WORK PAPERS CONCERNING WAKE TURBULENCE TESTS, 12 FEBRUARY–30 APRIL 1970
30 Apr. 1970 405 p refs
Avail: NTIS

CONTENTS:

1. FLIGHT-TEST EVALUATION OF THE WING VORTEX WAKE GENERATED BY LARGE JET-TRANSPORT AIRCRAFT W. H. Andrews, G. H. Robinson, G. E.Krier (NASA. Flight Res. Center), and F. J. Drinkwater (NASA. Ames Res. Center) 35 p ref (See N70-40912 23-02)
2. RESULTS OF THE BOEING COMPANY WAKE TURBULENCE TEST PROGRAM P. M. Condit (Boeing Co., Renton, Wash.) 70 p refs (See N70-40913 23-02)
3. MEASUREMENTS OF THE VORTEX WAKE CHARACTERISTICS OF THE BOEING 747, LOCKHEED C-5A, AND OTHER AIRCRAFT Data Report, 18–21 Feb. 1970 L. J. Garodz (Dept. of Transportation) 279 p ref (See N70-40914 23-02)
4. VORTEX HAZARD INDEX 3 p (See N70-40915 23-02)

N70-40912*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT-TEST EVALUATION OF THE WING VORTEX WAKE GENERATED BY LARGE JET-TRANSPORT AIRCRAFT
William H. Andrews, Glenn H. Robinson, Gary E. Krier, and Fred J. Drinkwater, III (NASA. Ames Res. Center) *In* FAA Comp. of Work Papers Concerning Wake Turbulence Tests 30 Apr. 1970 35 p ref (See N70-40911 23-02)
Avail: NTIS CSCL 01A

An evaluation of the behavior of the wing vortex wake of large, jet transport airplanes is presented. The primary objectives of the test program were to provide preliminary information to establish a logical terminal-area airspace separation criterion for all types of aircraft operating in the proximity of large transports. The flight tests were conducted to obtain data for the determination of the wing vortex wake location, persistence, and intensity behind the generating airplanes. In addition, a portion of the testing was directed toward evaluating the effects of the wing vortex wake on several different classes of aircraft. Author

N70-40913# Boeing Co., Renton, Wash. Commercial Airplane Div.
RESULTS OF THE BOEING COMPANY WAKE TURBULENCE TEST PROGRAM
P. M. Condit *In* FAA Comp. of Work Papers Concerning Wake Turbulence Tests 30 Apr. 1970 70 p refs (See N70-40911 23-02)
Avail: NTIS

The results of a flight test investigation of vortex wake turbulence generated by large jet transport aircraft are presented. Test results, showing the dynamic response of aircraft which were flown in the wakes of large jet transports, are discussed. Experimental results are compared to theoretical predictions. Test program results are applied to the problem of air traffic control and specific recommendations are presented for air traffic separations. Author

N70-40914# Department of Transportation, Washington, D.C. Test and Evaluation Div.
MEASUREMENTS OF THE VORTEX WAKE CHARACTERISTICS OF THE BOEING 747, LOCKHEED C-5A, AND OTHER AIRCRAFT Data Report, 18-21 Feb. 1970
Leo J. Garodz *In* FAA Comp. of Work Papers Concerning Wake Turbulence Tests 30 Apr. 1970 279 p ref (See N70-40911 23-02)
Avail: NTIS

A preliminary analysis of the flight test data is presented for the vortex wake characteristics of large, medium and small transport aircraft by low altitude tower fly-by techniques. The

instrumentation, tower, and fly-by techniques are described. Some of the conclusions reached are: (1) More persistent, clearly defined tubular-type vortex systems are generated as the flap setting is decreased on aircraft. (2) Tubular-type vortex systems are very persistent, up to approximately two minutes in age, as sighted visually and recorded photographically. (3) An airborne airflow measurement system is mandatory for longer time-history data out of the ground effect and out of the atmospheric boundary layer. F.O.S.

N70-40915# Federal Aviation Administration, Washington, D.C.
VORTEX HAZARD INDEX
In its Comp. of Work Papers Concerning Wake Turbulence Tests 30 Apr. 1970 3 p (See N70-40915 23-02)
Avail: NTIS

Equations are proposed for determining the vortex hazard index for the encountering aircraft. Equations are developed for calculating the vortex strength when the aerodynamic and inertia characteristics of the probe aircraft are known. It is concluded that further data is required to clarify the effect of the span of the encountering aircraft. F.O.S.

N70-40939# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
PROPELLER STATIC PERFORMANCE TESTS FOR V/STOL AIRCRAFT, PART 1 Summary Report, Jul. 1965 – Nov. 1967
Matthew H. Chopin Jan. 1969 186 p refs
(AD-708501; ASD-TR-69-15-Pt-1) Avail: NTIS CSCL 1/3

The tests were made because of a static performance thrust deficiency encountered during flight tests of the XC-142A V/STOL cargo aircraft. Twenty-eight versions of propellers were tested. Parameters studied during the tests included blade cuff (on or off), tip shape, twist, activity factor, camber, and airfoil section. Reduced data are presented in the form of performance coefficients and various tip Mach numbers for each configuration tested. Data on several other VTOL static thrust propellers are presented for additional information although they were not a part of this test series. Complete blade characteristic charts describing the physical characteristics of each blade tested provide a means of comparing the distribution of twist, thickness, chord, and camber against blade redial location for any given blade. Author (TAB)

N70-41014# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF GROUND EFFECT ON VERTICAL TAKEOFF AIRCRAFT
Charles Douglas Thompson (M.S. Thesis) Jun. 1970 74 p refs
(AD-709096) Avail: NTIS CSCL 1/3

The theoretical solution for the flow beneath V/STOL aircraft was extended to include tilted jet configurations. A laboratory model was constructed to test the effect of variation of the parameters governing the flow. Free streamline plots, pressure coefficients on the ground and fuselage and velocity profiles in the nozzles were determined from hot-wire anemometer traverses and micromanometer readings. Experimetal data compared favorably with the theoretical determinations. Author (TAB)

N70-41032# Civil Aeronautics Board, Washington, D.C.
STOL-VTOL AIR TRANSPORTATION SYSTEMS. CIVIL AERONAUTICS BOARD PLANNING STUDY
Carl Hintze, Jr. [1970] 37 p refs
Avail: NTIS

A consolidation of available information concerning the current status of STOL and VTOL aircraft, terminals, and allied facilities is arranged to indicate the consensus of opinion of the various authorities in the field. A brief description of the changing socio-economic aspects of the major metropolitan areas of the nation and their anticipated effects on urban transportation requirements is included. The probable course of events in the evolution of STOL and VTOL air transportation systems is summarized. Author

N70-41142# Civil Aeronautics Board, Washington, D.C.
IMPACT OF NEW LARGE JETS ON THE AIR TRANSPORT SYSTEM, 1970–1973
Nov. 1969 255 p refs
Avail: NTIS

An attempt to define the significant problem areas possibly emerging with the advent of wide bodied jet aircraft, including the Boeing 747, DC-10, and L-1011, and to estimate the economic impact resulting from the introduction of large numbers of these aircraft is discussed. Conclusions are presented concerning passenger capacity increases, domestic and international fares, routes and service patterns, economic viability, aircraft acquisition problems, airway and airport congestion problems, the future for air cargo, the impact on supplemental operations such as inclusive tour charters, the impact on cooperative arrangements, the impact on international operations, and an agreement relating to support equipment purchases. P.A.B.

N70-41172# Federal Aviation Administration, Washington, D.C. Information and Statistics Div.
COMMUTER AIR CARRIER OPERATORS AS OF SEPTEMBER 1969
[1970] 80 p
Avail: NTIS

Statistical operations and facilities data are tabulated for 153 commuter carriers of which 8 are designated as mail only carriers. The information is compared with other data on commuter carrier systems. E.H.W.

N70-41182*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A NEW APPROACH TO AERIAL COMBAT GAMES
Sheldon Baron, Kai-Ching Chu (Harvard Univ.), Yu-Chi Ho (Harvard Univ.), and David L. Kleinman Washington NASA Oct. 1970 100 p refs
(Contract NASI-8296)
(NASA-CR-1626; Rept-1916) Avail: NTIS CSCL 15G

The salient results of a study to apply differential game theory to aerial combat problems are presented. An approach to manned aerial combat games was developed that includes the statistical effects of human observation. This method was applied to two classical differential game problems. In addition, an approach to the dogfight problem was developed. Author

N70-41183*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVALUATION OF A MOVING-GRAPH INSTRUMENT DISPLAY FOR LANDING APPROACHES WITH A HELICOPTER
R. Earl Dunham, Jr. and Robert W. Sommer Washington Oct. 1970 24 p refs
(NASA-TN-D-6025; L-7241) Avail: NTIS CSCL 01D

A flight test evaluation was conducted of an instrument display for VTOL all-weather landing which included a moving graph pictorial presentation for slope guidance. The instrument display included a moving map presentation for course guidance, a large (4.5-inch-diameter (11.43-cm)) attitude indicator, and moving pointer airspeed and vertical-speed indicators. The tests were conducted under simulated instrument flight rules conditions in landing approaches with a helicopter along a 6 deg glide slope at an airspeed of 30 knots. Author

N70-41191# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
A DISCUSSION OF THE USE OF XENON FLASH LAMPS FOR ANTICOLLISION PURPOSES Final Report, Nov. 1969 – Apr. 1970
Peter L. Land May 1970 47 p refs
(AD-709191; ARL-70-0083) Avail: NTIS CSCL 1/2

The report points out a number of advantages which flash lamps have when used for anticollision light systems. A renewal of interest in the use of flash lamps for collision avoidance is noted, and this includes the related problem of avoiding bird strikes. Some of the important factors relevant to the effectiveness of anticollision lights, such as background illumination, intensity distribution and phase relations for a system of flashing lights are discussed. It is noted that the intensity distribution for a rotating beacon has cylindrical geometry, which is a limitation, and that phase relations for rotating or oscillating lamp systems are not and could not be easily maintained constant. It is noted that the advantages which flash lamps have in these respects are not always utilized; for example, at night the intensity distribution for a flash lamp anticollision light system should have the same form as that which applies to navigation lights. It is noted that during turns, the intensity patterns for most focused anticollision light systems are tilted out of the desired plane and it is suggested that for some aircraft it would be practical to sense and compensate for a banked condition. It is noted that flight test results show that flash lamp systems have been rejected mainly because the reflected light which may occur during various conditions caused pilot discomfort and may cause loss of dark adaptation and disorientation. Author (TAB)

N70-41193*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SIMULATION STUDY OF THREE INSTRUMENT DISPLAYS TO ASSIST IN AIRPLANE THRUST MANAGEMENT

Milton D. McLaughlin Washington Oct. 1970 44 p refs

(NASA-TN-D-5982; L-7200) Avail: NTIS CSCL 01D

Three displays were evaluated on a piloted simulator, each of which provided information which could be used in thrust management. The three displays were (1) rate of change of speed, (2) potential flight path angle, and (3) potential rate of climb. Results are presented in the form of time histories, histograms, and pilot comments. The results include comparisons of flight path and speed control and throttle activity with and without each display and pilot comments. Author

N70-41229# Naval Postgraduate School, Monterey, Calif.

THE EFFECTS OF TINTED PLEXIGLASS ON VISIBILITY IN THE AH-1G COBRA AIRCRAFT

Jac Darrell Lind Watson (M.S. Thesis) Apr. 1970 29 p refs

(AD-709405) Avail: NTIS CSCL 5/5

The problem of heat reduction in the AH-1G helicopter presented several options for solution. To alleviate the problem until permanent means could be devised for airconditioning the aircraft, tinted glass was installed. This immediately caused a series of objections to the glass because of the loss of vision by pilots at night. The problem of vision loss was studied using three independent variables: color, angle of the test glass to the line of sight, and target contrast. Author (TAB)

N70-41264# National Aviation Facilities Experimental Center, Atlantic City, N.J.

INDEX OF NAFEC TECHNICAL REPORTS Final Report, 1967 - 1969

Oct. 1970 61 p

(FAA-NA-70-67) Avail: NTIS

An index of all technical reports which were assigned NA numbers and published by NAFEC during the period 1967 through 1969 are submitted. Entries are arranged by NA number and include titles, authors and full abstracts. Separate sections contain indexes by subject, author, RD number, DS number, project number, contract number and AD number. Author

N70-41288# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero-Acoustics Branch.

MEASUREMENTS OF THE RADIATED NOISE FROM SAILPLANES Technical Memo, Aug. 1969 - Feb. 1970

D. L. Smith, R. P. Paxson, R. D. Talmadge, and E. R. Hotz Jul. 1970 116 p refs

(AD-709689; AFFDL-TM-70-3-FDDA) Avail: NTIS CSCL 20/1

The noise associated with a flight vehicle is generated by two distinct type sources: (1) the propulsion system and (2) the aerodynamic noise associated with movement of the vehicle through the atmosphere. The minimum noise will be radiated when the propulsion noise is eliminated. Measurements were taken of the noise radiated from three sailplanes in order to define the aerodynamic noise and to determine its relation to aircraft size and velocity. The report presents the results obtained from one microphone and relates the overall sound pressure level (SPL) to aircraft parameters. Author (TAB)

N70-41290# Federal Aviation Administration, Washington, D.C.

NEAR MIDAIR COLLISION REPORT OF 1968

15 Jul. 1969 207 p refs

Avail: NTIS

The classification and analysis of 2,230 near midair collision (NMAC) reports received during 1968 resulted in 1,128 of these reports being classified as hazardous to flight. Of these hazardous NMACs, 719 occurred in the terminal airspace—98 occurred at airports without control towers and 621 occurred within a 30 nautical mile radius of airports with control towers. The remaining 409 hazardous NMACs occurred within the enroute airspace. The data showed large clusters of reported NMACs occurring around large air transportation hubs and along published airways. The large metropolitan area reflected the heavy concentration of air traffic. Here, the number of near misses was directly related to the density of air traffic. All NMAC reports were considered for data collection. Each occurrence was classified as hazardous (critical or potential) or no hazard, based on a thorough analysis of the operational situation and on specific guidelines. Factors influencing the number of reported near misses in these hubs involved airport proximity, terrain, traffic flow, air traffic control services, and types of aircraft and operations. Author

N70-41439# Civil Aeronautics Board, Washington, D.C.

REMARKS BY THE HONORABLE SECOUR D. BROWNE, CHAIRMAN, CIVIL AERONAUTICS BOARD AT THE UNIVERSITY OF SOUTH FLORIDA'S SYMPOSIUM, 'AIR 70'

Secor D. Browne 1 May 1970 10 p Conf. held at Tampa, Fla., 1 May 1970

Avail: NTIS

The chairman of the Civil Aeronautics Board discusses the effects of pollution, air traffic control systems, airport locations, and advanced aircraft on the airline industry. Increasing movement of people in the foreseeable future requires stolports, an adequate traffic control system, and short-haul as well as supersonic transport aircrafts. G.G.

N70-41477# Honeywell, Inc., Minneapolis, Minn. Manned Systems Technology Group.

AIRCRAFT DISPLAYS FOR STEEP-ANGLE APPROACHES

James D. Wolf and Richard B. Hoppe Jul. 1970 379 p refs Sponsored in part by ONR and Army Electron. Command

(Contract N00014-68-C-0191)

(AD-709475; Rept-12571-FR1; JANAIR-681215) Avail: NTIS CSCL 1/4

The primary objective of the program was to investigate aircraft display requirements for steep-angle approaches and landings with 1975-1980 era tactical rotary-wing and V/STOL aircraft. The study was conducted with variable-velocity simulations of Bell UH-1 and Ryan XV-5 aircraft. Alternative display formats were developed and empirically evaluated by means of real-time man-in-the-loop simulation techniques. In addition, approach angle and profile characteristics were systematically varied to ascertain their effects on task performance. Interpreted within the constraints imposed

upon and by the simulations, results of the study indicated that manually controlled IFR steep-angle approaches and landings are possible with all display formats evaluated. Generally, horizontal situation display formats were found to yield more accurate and precise piloting performance with both vehicles. Effects of approach-profile variations were minor, while effects of approach angle did vary as a function of the vehicle flown and the axis of error or performance measurement. Author (TAB)

N70-41526# Federal Aviation Administration, Washington, D.C.
NATIONAL AVIATION SYSTEM PLANNING REVIEW CONFERENCE Summary Report
Apr. 1970 178 p Conf. held Washington, D.C., 14–17 Apr. 1970
Avail: NTIS

CONTENTS:

1. SATELLITE COMMUNICATIONS, NAVIGATION AND SURVEILLANCE p 1–13 (See N70-41527 23-07)
2. FACILITY ESTABLISHMENT CRITERIA p 15–19 (See N70-41528 23-11)
3. IMPLEMENTATION OF 50 kHz/Y CHANNELS FOR ILS/VOR/DME p 21–26 (See N70-41529 23-21)
4. FAA SERVICES AT NON-PUBLICLY OWNED AIRPORTS p 27–36 (See N70-41530 23-11)
5. FLIGHT INSPECTION SYSTEM p 37–39 (See N70-41531 23-21)
6. REDUCED TERMINAL IFR SEPARATION p 41–47 (See N70-41532 23-21)
7. CONTROL ZONES FOR INSTRUMENT APPROACHES p 49–52 (See N70-41533 23-21)
8. GENERAL AVIATION DATA SYSTEMS p 53–55 (See N70-41534 23-11)
9. COLLISION AVOIDANCE p 57–67 (See N70-41535 23-21)
10. INCREASED ENROUTE CAPACITY THROUGH INCREASED SECTORIZATION p 69–72 (See N70-41536 23-21)
11. AIRPORT/AIRWAY COST ALLOCATION STUDY p 73–77 (See N70-41537 23-11)
12. ATC DATA ACQUISITION CONCEPT p 79–95 (See N70-41538 23-21)
13. THE EVOLUTION OF STOL/VTOL SYSTEMS p 97–113 (See N70-41539 23-02)
14. AIRPORT CLASSIFICATION AND CERTIFICATION p 115–132 (See N70-41540 23-11)
15. NEW GENERATION ILS p 133–139 (See N70-41541 23-21)
16. ENVIRONMENTAL QUALITY p 141–150 (See N70-41542 23-02)
17. RESEARCH AND DEVELOPMENT PLANNING REVIEW p 151–153 (See N70-41543 23-34)
18. NATIONAL AVIATION SYSTEM POLICY AND PLAN p 155–158 (See N70-41544 23-34)

N70-41539# Federal Aviation Administration, Washington, D.C.
THE EVOLUTION OF STOL/VTOL SYSTEMS
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 97–113 (See N70-41526 23-02)
Avail: NTIS

Federal government policies, plans, and priorities for the evolutionary development of a STOL/VTOL city-center transportation system, as part of a balanced national air transportation system, are considered. Specific actions are suggested, such as the establishment of a V/STOL national goal, the use of the Northeast Corridor Project study to reevaluate current policies, the need for a fully coordinated STOL system definition, and provision of V/STOL services and facilities at all hub airports. Support of at least a 12 month STOL demonstration program is proposed. Time schedule charts concerning economic studies, R and D activities, certification, and STOLport design requirements and criteria are included. P.A.B.

N70-41542# Federal Aviation Administration, Washington, D.C.
ENVIRONMENTAL QUALITY
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 141–150 (See N70-41526 23-02)
Avail: NTIS

Aircraft noise and exhaust emission are discussed with reference to means to increase public acceptance of the problem and the extent to which the problem can be resolved with minimum regulation action. Federal efforts in the area of environmental quality are reviewed, along with the associated laws and executive orders. Opinions regarding the cause, effect, and steps necessary to resolve the noise and emission problems are presented, including work on airport regulations, airport planning, takeoff standardization, an engine retrofit program, and other engine design activities. P.A.B.

N70-41589* Martin Marietta Corp., Baltimore, Md.
LANDING GEAR Patent
Russell L. Hopping, William R. Forlifer, and Robert P. Gaston, Jr., inventors (to NASA) Issued 3 Jan. 1967 (Filed 10 Nov. 1964) 8 p Cl. 244-100 Sponsored by NASA
(NASA-Case-XMF-01174; US-Patent-3,295,798; US-Patent-Appl-SN-410331) Avail: US Patent Office CSCL 01C

A landing gear system for vertically descending flight vehicles is described which is applicable to rough as well as smooth surfaces. Energy absorbing struts, arranged in diametrically opposed pairs, are adapted to extend from the vehicle to make initial contact with the landing surface. Each strut is free to slidably retract upon contact. Electrical switches, associated with each pair of struts to actuate a locking means, are series connected so that any given strut is not actuated until its opposed strut has contacted the landing surface. The system assures that the landing forces transferred from the struts to the vehicle are always balanced symmetrically with respect to the vertical axis of the vehicle. The landing may be effected safely even on a sloping surface. P.A.B.

N70-41630* Ryan Aeronautical Co., San Diego, Calif.
WING DEPLOYMENT METHOD AND APPARATUS Patent
John Dale Sutliff, inventor (to NASA) Issued 31 Jan. 1967 (Filed 28 Jan. 1965) 6 p Cl. 244-138 Sponsored by NASA
(NASA-Case-XMS-00907; US-Patent-3,301,511; US-Patent-Appl-SN-428890) Avail: US Patent Office CSCL 01C

A deployment method is described in which a flexible wing glider is pulled from its housing in a space vehicle by a pilot chute and then sequentially opened in a controlled and predetermined series of steps until full aerodynamic form is reached, each step occurring with a minimal amount of impact and loading on the system. A mechanism is also provided to orient the spacecraft beneath the wing before its full aerodynamic form is reached in order to achieve an optimal guidance and control position immediately upon full deployment. R.B.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N70-40474# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
FEASIBILITY STUDY AND PRELIMINARY DESIGN FOR A

100-KW PERMANENT MAGNET GENERATOR Final Technical Report, Jun. 1969 – Jan. 1970
Elton F. Hammond, Jr., Carroll C. Kouba, and Jack L. McCabria Jun. 1970 160 p refs
(Contract DAAK02-69-C-0763)
(AD-708930) Avail: NTIS CSCL 10/2

The feasibility of using recently developed permanent magnet materials for field excitation in a high speed generator was investigated and a preliminary design prepared. It was found that a design was feasible with only one of the permanent magnet materials - samarium cobalt (SmCo5). Analyses were performed in the areas of electromagnetic design, mechanical design, rotor dynamics and in the thermal aspects of the permanent magnet generator (PMG). Preliminary design sketches and layouts are presented. Four potential problem areas were identified, but it was concluded that the PMG is feasible and that there is a high probability of its successful development. Author (TAB)

N70-40558# Eagle-Picher Co., Joplin, Mo. Couples Dept.
HIGH-RATE MAGNESIUM/MANGANESE-DIOXIDE BATTERIES FOR FIELD APPLICATION FROM −40 F TO 125 F Final Report, Apr. 1968 – Apr. 1970
Jerry L. Russell May 1970 59 p
(Contract DAAB07-68-C-0228)
(AD-708577; ECOM-0228-F) Avail: NTIS CSCL 10/2

The report describes the design, fabrication and testing of two different high-rate, high-energy density primary batteries employing a magnesium/magnesium-perchlorate/manganese-dioxide system. The batteries consist of the 4-pound BA-838( )/U and the 6-pound BA-839( )/U. The batteries are capable of supplying as high as 37 watt-hours/lb. for the BA-838( )/U and 45 watt-hours/lb. for the BA-839( )/U. Both batteries are capable of operating from -40F to +125F and of surviving severe dynamics. An inexpensive activator mechanism is employed that makes possible a rapid simple means for simultaneously activating all 16 cells of the battery. Author (TAB)

N70-40593# Mallory (P.R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science.
LONG SHELF LIFE ORGANIC ELECTROLYTE BATTERY Quarterly Report, 21 Nov. 1969 – 20 Mar. 1970
A. N. Dey and L. F. Athearn Jul. 1970 39 p
(Contract DAAB07-70-C-0076)
(AD-708576; ECOM-0076-1; QR-1) Avail: NTIS CSCL 10/3

The fabrication of organic electrolyte cells having a wide operating temperature range and high energy density has proceeded through the design phase. Preliminary testing of small scale cells has begun. Procurement of tooling, special equipment, cell materials and hardware is proceeding on schedule. Author (TAB)

N70-40673# Army Electronics Command, Fort Monmouth, N.J.
HIGH ENERGY DENSITY, LONG LIFE, ZINC-SILVER OXIDE SECONDARY BATTERY BB-534()/U (ENGINEERING EVALUATION)
E. J. Settembre Jun. 1970 21 p refs
(AD-708866; ECOM-3287) Avail: NTIS CSCL 10/3

The physical and electrical characteristics for a high energy density zinc-silver oxide battery and battery assembly are presented. The BB-534()/U consists of four (4) vented zinc-silver oxide BB-461()/U monobloc batteries housed in a lightweight, rugged, standard manpacked case. The storage life of this battery is extended by shipping in the dry unactivated state. Electrolyte is supplied in sealed plastic containers. Before use the battery is filled and charged. This battery has the capability of furnishing over 9.0 Ah at 24 volts, or 18.0 Ah at 12 volts and meets severe electrical, environmental and mechanical requirements. Further, this battery assembly provides the greatest available energy per unit weight and volume of any battery assembly in the standard family of alkaline batteries. Author (TAB)

N70-40885# Technische Hochschule Stuttgart (West Germany).
PERFORMANCE LIMIT OF AN INCORE THERMIONIC CELL [GRENZLEISTUNG EINER INCORE-THERMIONIKZELLE]
Waldemar Haug (Ph.D. Thesis) 25 Jun. 1969 109 p refs In GERMAN
Avail: NTIS

Mathematical models are presented for determining thermal and electrical properties of thermionic cells. A solution to the Fourier heat transfer equation in a (r,z)-geometry delivers the temperature field and the Rasor model is used to produce electron emission on emitter surface and electrical properties of the cell volume. These optimization methods develop operational cell limitations and project their occurrences. Also discussed are some possibilities to improve the electrical performance of thermionic cells. Transl. by G.G.

N70-40936*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: ACCEPTANCE TEST OF SONOTON E CORPORATION 20 AMPERE-HOUR NICKEL-CADMIUM CELLS
J. D. Harkness 28 Aug. 1970 27 p
(NASA Order W-12397)
(NASA-CR-113822; QE/C-70-691) Avail: NTIS CSCL 10C

Acceptance tests were performed on 50 Sonotone 20 ampere-hour spacecraft cells. Twenty-five cells were of the standard sealed nickel-cadmium construction type, whereas the remaining 25 cells have the standard construction plus a constant mechanical pressure normal to the face of the nickel-cadmium stack. The effect of mechanical pressure on the cell plates of nickel-cadmium cells was studied. Author

N70-40972*# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
SOLID STATE POWER MANAGEMENT
I. Rakofsky *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 323–337 (See N70-40951 23-31)
Avail: NTIS CSCL 10B

Analytic and design studies of contactless solid-state electric power management systems for advanced aerospace vehicles are discussed. Contactless electric power management systems are designed to replace all conventional electromechanical switching devices with functionally equivalent static devices and/or circuitry, to use low-level, digital solid-state concepts to implement control logic, to incorporate multiplex data transmission for transmission of signals, to include a fault detection/isolation test capability, and to use digital data processing techniques for power control, power management, system test, and data transmission integration. The techniques and schematics of incorporating such systems into space shuttle vehicles are presented. R.B.

N70-40973*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POWER PROCESSING AND DISTRIBUTION FOR THE SPACE SHUTTLE CRAFT
Francisc C. Schwarz *In its* Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 339–348 (See N70-40951 23-31)
Avail: NTIS CSCL 10B

The electric power processing and distribution system for transforming power from one form to another and for transferring power from the generator to the corresponding load centers of space shuttle vehicles is considered. The physical characteristics of the system, with comparison of ac and dc power requirements, are described. Recommendations are made for achieving the power system requirements and associated constraints. R.B.

N70-40974*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FUEL CELL TECHNOLOGY PROGRAM
David Bell *In its* Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 349-360 (See N70-40951 23-31)
Avail: NTIS CSCL 10B

The advanced fuel cell program to support the primary electrical power requirements of space shuttle vehicles in the mid-1970's is discussed. The objective is to advance the technology of hydrogen-oxygen fuel cells through a rigorous and comprehensive program commencing at the lowest component and material level and progressing through the fabrication and test of an engineering model fuel cell and related components and assemblies. Author

N70-40975*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE SHUTTLE AUXILIARY POWER UNIT (APU)
Donald G. Beremand and Harry M. Cameron *In its* Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 361-371 (See N70-40951 23-31)
Avail: NTIS CSCL 10B

A program to develop the technology of a hydrogen-oxygen fueled auxiliary power unit (APU) for the space shuttle vehicle is discussed. The requirements for such an APU vary somewhat from one vehicle concept to another and between the booster and orbiter vehicles. A review of the project requirements from the various studies has led to selection of a representative set of APU requirements for initial use in the APU program. The APU requirements are summarized briefly, and are established to be compatible with basic space shuttle requirements (100 missions) and to reflect a common APU for both orbiter and booster vehicles. Author

N70-41013*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: ACCEPTANCE TEST OF GULTON INDUSTRIES, INCORPORATED AND GENERAL ELECTRIC COMPANY 6.0 AMPERE-HOUR NICKEL-CADMIUM CELLS
D. E. Christy 28 Aug. 1970 20 p
(NASA Order W-12397)
(NASA-CR-113824; QE/C-70-690) Avail: NTIS CSCL 10C

The results of the acceptance tests for nickel-cadmium cells are presented. All tests were conducted at an ambient temperature between 23 and 27 C at existing relative humidity and atmospheric pressure, and consisted of the following: (1) physical inspection, (2) capacity tests, (3) cell short test, (4) leak test, (5) overcharge test, (6) internal resistance measurement, and (7) leak test. Results are summarized. Author

N70-41060# American Cyanamid Co., Stamford, Conn. Research Labs.
SIX-POUND WATER ACTIVATED ZINC-AIR STANDARD LINE BATTERY BA-535()/U Final Report, Jan. 1969-May 1970
Raymond J. D. Smith Jul. 1970 32 p
(Contract DAAB07-69C-0276)
(AD-709633; ECOM-0276-F) Avail: NTIS CSCL 10/3

Twenty six-pound water activated 24 volt 20 ampere-hour zinc-air batteries were fabricated, of which eleven were supplied impregnated with potassium hydroxide for water activation and nine were supplied without KOH impregnation but with 34% aqueous KOH electrolyte separately packed. Acceptance testing of the battery at 75F, 40% R.H. was successfully carried out, the sample selected yielding 24.2 A-h, or a power density of 84 watt hrs/lb. Author (TAB)

N70-41062*# Globe-Union, Inc., El Monte, Calif. Centralab Semiconductor.
OPTIMIZED SILICON SOLAR CELLS FOR SPACE EXPLORATION POWER SYSTEMS
Peter A. Iles and James M. Palmer 7 Aug. 1970 29 p refs
Prepared for JPL
(Contracts NAS7-100; JPL-952865)
(NASA-CR-113878) Avail: NTIS CSCL 10B

Several studies are described in detail relating to the improvement of silicon solar cells and their optimization for operation in the vicinity of Mercury and Venus. The studies were conducted in the areas of thermal characteristics and series resistance. As a result of these studies near-optimum cells were designed for Mercury and Venus missions. Experimental cell fabrication will resolve the remaining factors. Author

N70-41146*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
DESIGN AND DEVELOPMENT OF A BRUSHLESS, DIRECT-DRIVE, SOLAR ARRAY REORIENTATION SYSTEM (BRUSHLESS MOTOR COMMUTATOR-CONTROLLER DEVELOPMENT), PHASE 2 Quarterly Report
R. D. Jessee Jun. 1969 25 p refs
(Contract NAS5-10459)
(NASA-CR-113909; QR-1) Avail: NTIS CSCL 09E

The modifications to correct unresolved problems in the design of the electronic controller-commutator of a brushless dc torque driver motor are presented. The problem areas discussed are: (1) magnetic sensor outputs are unequal and wave form irregular, (2) pulse width of motor voltage varies as a function of rotor position, and (3) torque variation. It is concluded that the inequality of signals from the magnetic sensor was corrected by modification of the output windings so that each pair of poles have the same number of turns per pair. The variation in pulse width of the voltage with the torque variations were eliminated by rectifying the sensor outputs, and revising the circuit to operate from the resultant dc signals. It is recommended that all sensor output coils be identical in future motors. F.O.S.

N70-41178*# Clevite Corp., Cleveland, Ohio.
DEVELOPMENT OF IMPROVED CADMIUM SULFIDE SOLAR CELLS Final Report, 18 Feb. 1969-18 Mar. 1970
H. E. Nastelin, P. L. Di Renzo, and A. L. Gombach Sep. 1970 77 p refs
(Contract NAS3-11845)
(NASA-CR-72754) Avail: NTIS CSCL 10C

Normal pilot line fabrication of standard process cells was limited by a period of low production yields. Long term storage stability testing was continued on three different tests, dry shelf storage, moisture storage, and 100 C-vacuum storage. Machine roll-coated Ag-Pyre ML substrates were substituted for the standard sprayed substrates and showed an improved production yield as well as an apparent improvement in performance. Evaporated and electroplated chromium were unsuccessfully substituted for electroplated zinc as the interlayer material. FEP Teflon as a cover plastic was successfully attached to gridded cells with adhesives and heat bonding. Its evaluation is continuing. Evaporated grids were successfully deposited but their resistance was much greater than that of the present grid and no practical method of reducing this resistance was found. The CdS evaporation process was investigated and significant temperature gradients were found to exist on the substrate during simulated evaporation cycles. Their cause was traced to aluminum evaporation masks mounted in front of the substrate. The evaporation rate profiles of two designs of evaporation sources were also studied. Author

N70-41301# Technische Univ., Berlin (West Germany).
ON THE CAPACITY BEHAVIOR OF BAFFLE PLATE

VALVES [UEBER DAS LEISTUNGSVERHALTEN VON PRALLPLATTENVENTILEN]
Hans-Edgar Kallies (Ph.D. Thesis) 1968 130 p refs In GERMAN
Avail: NTIS

The performance of baffle plate valves in hydraulic pressure systems is evaluated by considering mainly pressure and temperature regimes of electrohydraulic servovalves in pneumatic control and guidance technology. Characteristics of valve behavior are determined for high pressure hydraulics up to 350 atm by forming equations for valve thresholds at flow-proportional and power-proportional baffle plate displacements and by considering the effect of mass flow passage on valve thresholds. It is shown that passage flow parameters depend on the stream compression caused by viscous friction inside the pressure regulating valve. Transl. by G.G.

N70-41478*# Exotech, Inc., Washington, D.C.
DESIGN CRITERIA MONOGRAPH FOR SPACE VEHICLE SOLAR CELL ARRAYS Interim Scientific Report
Robert G. Lyle Jun. 1970 67 p
(Contract NAS12-2237)
(NASA-CR-113923; ISR-2) Avail: NTIS CSCL 10B

The capabilities and limitations of silicon solar cell arrays are discussed with respect to energy conversion efficiency, methods for optimizing electrical characteristics, alternatives of mechanical and electrical configuration design, and environmental factors which affect the performance and reliability of solar cells. The results of a meeting of the ad hoc advisory panel to review, critique, and supplement the design criteria monograph are presented. R.B.

N70-41580* Goodyear Aerospace Corp., Akron, Ohio.
FOLDABLE SOLAR CONCENTRATOR Patent
Thomas J. McCusker, inventor (to NASA) Issued 3 Jan. 1967 (Filed 3 May 1963) 8 p Cl. 126-270 Sponsored by NASA
(NASA-Case-XLA-04622; US-Patent-3,295,512; US-Patent-Appl-SN-277833) Avail: US Patent Office CSCL 10B

A double reflector, consisting of a foldable cone reflector and a collapsible parabolic cylinder reflector located on the axis of the cone, is described. The open cone reflector is made of a flexible sheet having an inner surface highly reflective to solar rays, such as Mylar. A heat receiver is at the opening of the cone on the cone's axis, and the parabolic column reflector is connected to the heat receiver so that it extends into the dish substantially to the apex of the cone. The column reflector consists of several parabolic elements with diameters decreasing toward the apex of the cone to permit telescoping for storage. The cone and parabolic reflectors are designed so that solar rays incident on the cone are reflected to a parabolic element, back to the cone, and then to a focal point on the heat receiver. N.E.N.

N70-41798# Lockheed Missiles and Space Co., Palo Alto, Calif.
GENERALIZED DEPENDENCES TO DETERMINE THE OPTIMAL OPERATING MODE OF A THERMOELECTRIC GENERATOR
R. V. Kovalskii 1970 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transp. (Moscow), no. 3, 1970 p 160-164
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Generalized dependences have been obtained for the determination of optimal values of the loading coefficient m for which a thermoelectric generator will have maximum efficiency or maximum power. These dependences can be utilized for different thermal modes of generator operation and take account of the influence of heat leaks in the intra-element insulation. The optimal value of m will be greater the stronger the dependence of the temperature drop at the thermal cell junctions on the generator load current is. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N70-40402 + Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
MEASUREMENTS IN GLOBAL LEVELS, OCTAVE BAND AND PERCENTILE BAND ANALYSIS OF THE NOISE PRODUCED BY ROOTS COMPRESSOR FOR THE EVALUATION OF ANNOYANCE IN INDUSTRIAL PLANT [MEDIDAS EM NIVEIS GLOBAIS E ANALISE EM FAIXAS DE OITAVAS E FAIXES PERCENTUAIS DO BARULHO PRODUZIDO POR COMPRESSOR ROOT PAR VERTIFICACAO DO INCOMODO PRODUZIDO PELO BARULHO]
L. X. Nepomuceno 3 Jul. 1970 13 p refs In PORTUGESE; ENGLISH summary
(Rept-7007.441) Avail: NTIS

The equipment inspected, the adopted procedure and instruments used for the measurement of the noise in global levels according to ISO curves, octave band and percentile band analysis are described. The results are presented in tabular form and in graphical spectral form for the octave and percentage band analysis between 20 Hz and 20.000 Hz. Considerations concerning the annoyance produced by the compressor noise and the legal implications due to excessive noise are included. Author

N70-40403# Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
NOISE MEASUREMENT AND ANALYSIS IN OCTAVE BAND AND PERCENTILE BAND WITH CONSIDERATIONS ON THE LEGAL ASPECTS, CONCERNING COMPRESSOR NOISE [MEDIDAS EM NIVEIS GLOBAIS, ANALISE EM FAIXAS DE OITAVAS E FAIXAS PERCENTUAIS DO BARULHO PRODUZIDO POR COMPRESSORES E AS IMPLICACOES LEGAIS DO EXCESSO DE BARULHO]
L. X. Nepomuceno 6 Jul. 1970 16 p refs In PORTUGUESE; ENGLISH summary
(Rept-7007.442) Avail: NTIS

The observed compressor, the equipment used and procedure adopted for the noise measurement and analysis in global level, octave band and percentile band analysis are reported. The results are presented in tabular form with graphical presentation of both spectra. Considerations on the excess noise level and the legal implications in working surroundings are included. Author

N70-40419# Naval Postgraduate School, Monterey, Calif.
THE EFFECT OF AN EXTERNAL AUDIO SIGNAL ON VIGILANCE PERFORMANCE AND PHYSIOLOGICAL PARAMETERS
William Stanley Marshall, III (M.S. Thesis) Apr. 1970 46 p refs
(AD-709088) Avail: NTIS CSCL 5/10

Research was performed to determine the effect of an external audio signal on visual monitoring performance and any associated changes in physiological parameters of the subjects. The number of correct detections, the number of commissive errors, skin temperature, and skin resistance were recorded throughout the experiment. A two way nested analysis of variance correlated application of the audio signal to vigilance decrement. Multiple correlation analyses of the data indicated a high degree of complex interaction between the physiological parameters measured and the vigilance detection decrement. Author (TAB)

N70-40420# Columbia Univ., New York. Psychophysics Lab.
A BRIEF HISTORY OF RESEARCH ON THE PHYSICAL FACTORS INVOLVED IN AUDITORY LOCALIZATION

John Molino 1 Jul. 1970 17 p refs
(Contract N00014-67-A-0108-0005)
(AD-709082; PLR-15) Avail: NTIS CSCL 6/16

Research on the physical factors involved in human auditory localization is presented in brief historical review. The intensity, phase, and time theories are followed in their development as possible explanations for auditory spatial discriminations. Theoretical calculations and empirical measurements are cited for the physical differences in the stimuli reaching the two ears from sources located in various azimuth directions. Basic psychophysical data are given for the subjective location of sound source images produced by distant external sound radiators and by acoustic stimuli delivered through earphones and tubes. Emphasis is upon the localization of pure tone stimuli in a free acoustic field or its simulation. Author (TAB)

N70-40439# Dartmouth Coll., Hanover, N.H. Dept. of Physiology.
METALLIC MICRONUTRIENTS AND INTERMEDIARY METABOLISM Final Progress Report
Henry A. Schroeder 30 Jun. 1970 22 p refs
(Contract DA-49-193-MD-2595)
(AD-708581; PR-3) Avail: NTIS CSCL 6/16

In order to evaluate biological effects of trace elements, and to ascertain relationships to chronic diseases of man, mice and rats were exposed for their lifetimes to small doses of each of 26 essential and abnormal elements in drinking water, in a laboratory and on a regimen designed to avoid environmental contamination. Growth rates, survival and longevity, microscopic pathology of tissues, concentrations of trace elements in tissues, and in rats, blood pressure, serum cholesterol, glucose and uric acid, aortic plaques and lipids and tumor rates were measured or examined. Surveys of the human environment for 21 elements in foods, water, vegetation, wild animals were also made, by trace element analysis, and human tissue concentrations for 6 elements. As a result of this work, two prevalent human diseases have been reproduced in rats. A model for human arterial hypertension has been developed in rats fed cadmium and a model for human atherosclerosis has been developed in rats deficient in chromium and in those fed refined white sugar. The following elements were carcinogenic: selenium, yttrium, rhodium, palladium and tellurate. These elements were more or less toxic in mice and/or rats: selenite, germanate, cadmium, tin, antimony, tellurium, lead. Author (TAB)

N70-40443# Ohio State Univ. Research Foundation, Columbus.
PERFORMANCE BASELINES FOR INFRA-HUMAN RESEARCH: A COMPILATION AND ANALYSIS OF THE LITERATURE ON SCHEDULES OF REINFORCEMENT, 1957 – 1968 Final Report
Reed Lawson, Ronald C. Huff, and Laurence Miller Apr. 1970 350 p refs
(Contract AF 29(600)-5735)
(AD-708506; ARL-TR-70-10) Avail: NTIS CSCL 5/10

The report is a comprehensive (though not exhaustive) examination of research conducted on 15 schedules of operant reinforcement with infra-human subjects. Each schedule is viewed separately both as an independent and as a dependent variable. Complex schedules such as multiple, conjoint, interlocking, and Titration are included as well as the more common fixed ratio, fixed interval, DRL, Sidman avoidance, etc. Measurement considerations peculiar to certain schedules such as quarter-life with FI and post-reinforcement pause with FR are discussed and, where the data allow, conclusions are drawn regarding the advantages and limitations of each schedule in attacking particular problems such as matching-to-sample, drug screening, and psychophysical phenomena. Author (TAB)

N70-40569# Dynamic Science, Phoenix, Ariz. AvSER Facility.
HUMAN TOLERANCE TO ABRUPT ACCELERATIONS. A SUMMARY OF THE LITERATURE
William R. McKenney May 1970 68 p refs
(AD-708916; AvSER-70-13) Avail: NTIS CSCL 6/19

This report summarizes the history and research and associated problems in investigation of human abrupt accelerations. Enumeration of possible impact injury follows discussion of the five parameters of human tolerance. Tolerable levels of acceleration impact were extracted from current literature. Author (TAB)

N70-40619# Texas Nuclear Corp., Austin.
EXTERNAL BEAM MEASUREMENTS ON THE TEXAS A. AND M. VARIABLE ENERGY CYCLOTRON Final Report, Mar. 1968 – May 1969
Ben S. Burton, C. Varren Parker, Jr., and Larry A. Boles Brooks AB, Tex. School of Aerospace Med. May 1970 18 p refs
(Contract F41609-68-C-0029)
(AD-708428; SAM-TR-70-25) Avail: NTIS CSCL 6/18

The external proton beam of the Texas A. + M. University Variable Energy Cyclotron (TAMVEC) was studied to determine its suitability for special large-animal irradiations. Broad, uniform beams were produced by multiple-coulomb scattering of the narrow primary beam. Various energies were produced by placing absorbers in the beam or by varying the cyclotron energy, or by using both technics. Beam uniformity, energy, energy-spread, dose rate, and, in some instances, depth-dose profiles were measured in the exposure plane for a number of energies. The USAF School of Aerospace Medicine personnel measured depth-dose distributions with thermoluminescent dosimeters embedded in plastic phantoms. Author (TAB)

N70-40662 Michigan Univ., Ann Arbor.
CELLULAR BIOCHEMICAL RESPONSE TO OZONE INHALATION: AN EXPERIMENTAL METHOD FOR THE STUDY OF THE TOXICITY OF AIR POLLUTANTS
Ahmed Nasr Mohamed Nasr (Ph.D. Thesis) 1969 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-18066

Ozone, an important component of smog in certain urban atmospheres, was used to test the model and to explore a biochemical lesion that may be involved in the basic mechanism of its toxicity. Epithelial cell suspensions were prepared from the trachea of the rat by the brush-technique. The ratio of reduced to oxidized nicotinamide adenine dinucleotide phosphate (NADP) was determined in the tracheal epithelium of normal rats, and rats which inhaled ozone at a high concentration. The oxidized and reduced forms of NADP were assayed by the method of enzymatic cycling. The interaction between ozone, in vitro, and both NADP(+) and NADPH was also investigated. Dissert. Abstr.

N70-40666# School of Aerospace Medicine, Brooks AFB, Tex.
EFFECTS OF RADIATION ON CANINE LOCOMOTION Final Report, Nov. 1968 – Nov. 1969
John W. Watters Jun. 1970 12 p refs
(AD-708431; SAM-TR-70-32) Avail: NTIS CSCL 6/18

Sixteen dogs were used to determine the effect of ionizing radiation on canine locomotion. The animals were run on a treadmill, at speeds of 3 to 5 m.p.h. for periods of 60 to 75 min., with intermittent rest periods. Microswitches were attached to each dogs feet to determine the downtime for each foot. The radiation exposures ranged from 380 to 5005 rads of neutron-gamma ratios of 1:20 for ten dogs and 9:1 for the other six animals. The most common symptom after radiation exposure was vomiting. However, the emesis did not appear to be dose dependent. Although changes in the support formula could be demonstrated after irradiation, no statistical significance could be applied because of the limited number of subjects involved and because of the great variation in exposure levels and in neutron-gamma ratios. Author (TAB)

N70-40677*# Martin Marietta Corp., Denver, Colo.
STUDY PROGRAM TO DEFINE A MEDICAL AND PARAMEDICAL INVESTIGATION OF MAN IN A CLOSED

ECOLOGICAL ENVIRONMENT. VOLUME 2: ANNOTATED BIBLIOGRAPHY

Diane L. Dapper, comp. Jun. 1970 435 p refs
(Contract NAS9-10314)
(NASA-CR-108598; MCR-70-227-Vol-2) Avail: NTIS CSCL 06E

The annotated bibliography contains 821 references which are considered to be representative of the literature concerned with man and animals in closed ecologies and in simulated space environments. The articles focus on the years 1960 to April 1970. In order to provide a contrast, references are also included on topics not influenced by aerospace environmental conditions. The bibliography is divided into space cabin, closed ecological chamber and life support systems, biological function and regulation, microbiology, related scientific disciplines, and safety measures. Author

N70-40841# Advisory Group for Aerospace Research and Development, Paris (France).

FLUID DYNAMICS OF BLOOD CIRCULATION AND RESPIRATORY FLOW

Jul. 1970 315 p refs Presented at a Specialists Meeting, Naples, 4–6 May 1970
(AGARD-CP-65-70) Avail: NTIS

Dynamic aspects of human blood circulation and respiratory flow physiology are discussed in detail. Hematological effects of prosthetic devices and hemodynamic gas transport in the respiratory system are somewhat emphasized. For individual titles see N70-40842 through N70-40875.

N70-40842# Cambridge Univ. (England).

MOTION IN VERY NARROW CAPILLARIES

M. J. Lighthill *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 5 p refs (See N70-40841 23-04)
Avail: NTIS

Mathematical models are formulated for the mechanics of erythrocytes in capillaries with emphasis on lubrication aspects in the passage of red cells through narrow tubes. Estimated is the thickness of any layer of plasma separating a cell from the endothelial wall and how such a layer contributes to mass transport and resistance. A general feature of the model is a parameter relating red cell constrictability to characteristic viscous stress. G.G.

N70-40843# Illinois Univ., Chicago.

HEMODYNAMIC AND MASS TRANSFER IMPLICATIONS OF PHASE SEPARATION PHENOMENA IN THE MICROCIRCULATION

George Bugliarello *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 10 p refs (See N70-40841 23-04)
Avail: NTIS

Phase separation phenomena have an immediate physiological significance in the microcirculation, where they become increasingly important in proceeding from the larger vessels to the capillaries. Investigations of several aspects of these phenomena are summarized by: (1) in-vitro studies with human blood of the characteristics of the peripheral erythrocyte-poor layer, including the relation between its size and flow and geometrical variables, and some observations on the influence of gravity effects; (2) numerical simulations of the energy dissipation and oxygen transfer in the axial gaps between erythrocytes in the capillaries, with emphasis on the influence of erythrocyte spacing and erythrocyte configuration; (3) physical model studies of hematocrit differences occurring in the branches of bifurcations as a result of concentration differentials in the cross-section upstream of the bifurcation; and (4) numerical and physical studies of the detailed hydrodynamic behavior of an erythrocyte-shaped body, including forces on the body, and the pressure and flow field generated by it as it moves in an unconfined fluid, near a boundary and past another erythrocyte-shaped body. Author

N70-40844# Grenoble Univ. (France). Faculte de Medecine.

HEMODYNAMIC POSSIBILITIES OF A PARTIAL OR TOTAL CARDIAC ASSISTANCE [POSSIBILITES HEMODYNAMIQUES D'UNE ASSISTANCE CARDIAQUE PARTIELLE OU TOTALE]

L. Vadot *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 6 p refs In FRENCH (See N70-40841 23-04)
Avail: NTIS

Solutions for effecting the accomplishment of a double aim, i.e., to replace the heart in its operational function either partially or totally while favoring myocardium regeneration, are examined with respect to imposing an artificial branched flow circulation on the natural circulatory system. Continuous or pulsed flow, synchronization or nonsynchronization of the artificial heart with the natural heart, simultaneous operation of the natural and artificial hearts and competition between the two, total assistance, and assistance efficiency are among the questions investigated. Transl. by P.A.B.

N70-40845*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE EFFECT OF GRAVITY ON THE CARDIOVASCULAR AND RESPIRATORY SYSTEMS

John Billingham *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 7 p refs (See N70-40841 23-04)
Avail: NTIS CSCL 06S

The effects of alterations in gravitational or inertial forces on blood and gas flows in the cardiovascular and respiratory systems are functions of the magnitude, direction, rates of change and duration of the imposed forces. Changes in flow under varying conditions are secondary to deformations and other changes of the blood vessels, airways and their surrounding structures, and are produced both passively and through active reflex mechanisms of a variety of physiological control systems. Changes produced in the systemic cardiovascular system are described for the terrestrial gravitational field, for the high accelerations produced by aircraft and spacecraft maneuvers or centrifuges, and for the weightless condition of the space environment. Changes in the pulmonary circulation are considered along with alterations in lung structure, airway dimensions and respiratory gas flows, since both are intimately linked in determining oxygen and carbon dioxide contents of the arterial blood. Author

N70-40849# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.

GRAVITY DEPENDENCE OF PULMONARY CAPILLARY BLOOD FLOW

David H. Glaister *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 9 p refs (See N70-40841 23-04)
Avail: NTIS

Diagrams of the human lung are presented that show the level to which blood flow rises at various acceleration stresses in erect, supine, inverted, and prone body positions. The various factors which affect the flow of blood through pulmonary capillaries at different levels in the lung are depicted and range from collapsed capillaries at the top of the lung over a sluice flow region, governed by the hydrostatic pressure gradient present within pulmonary arteries, down to the last level where blood vessels as well as air ways are occluded and blood flow is absent. G.G.

N70-40850# Western Ontario Univ., London. Dept. of Biophysics and Medicine.

THE EFFECT OF LOW FREQUENCY VIBRATION ON ARTERIAL WALL ELASTIC

D. R. Boughner and Margot R. Roach *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 10 p refs (See N70-40841 23-04)
Avail: NTIS

Poststenotic dilatation and intravascular turbulence both occur distal to an arterial narrowing. The dilatation is due to altered elastic properties of the vessel wall while the turbulence produces palpable and audible vibration of the wall. The vibration may produce the dilatation. Twenty-three human external iliac arteries were exposed to individual frequencies contained in murmurs. Dilatation occurred in response to one or more of the frequencies to which each was exposed and the altered elastic properties were similar to the changes seen in poststenotic dilatation. The age of the vessel determined the frequency required to produce dilatation. Author

N70-40851# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.

SOME ASPECTS OF CARDIOVASCULAR BEHAVIOR DURING LOW-FREQUENCY VIBRATION

Robert M. Nerem *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 13 p refs (See N70-40841 23-04)
Avail: NTIS

The behavior of the cardiovascular system during low-frequency whole-body vibration, such as encountered by astronauts during launch and reentry, is examined from a fluid mechanical viewpoint. The vibration characteristics of typical manned spacecraft and other vibration environments are discussed, and existing results from in vivo studies of the hemodynamic aspects of this problem are reviewed. Recent theoretical solutions to related fluid mechanical problems are then used in the interpretation of these results and in discussing areas of future work. Included are the results of studies of the effects of vibration on the work done by the heart and on pulsatile flow in blood vessels. It is shown that important changes in the instantaneous velocity profile, mass flow rate, and wall shear stress may occur in a pulsatile flow due to the presence of vibration. The significance of this in terms of changes in peripheral vascular resistance and possible damage to the endothelium of blood vessels is discussed. Author

N70-40852# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

EFFECT OF POSITIVE AND NEGATIVE CENTRIFUGAL ACCELERATION ON RENAL BLOOD FLOW OF UNANESTHETIZED DOGS

John E. Chimoskey (Hahnemann Med. Coll.) *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 6 p refs (See N70-40841 23-04)
Avail: NTIS

Trained unanesthetized dogs were exposed to positive and negative centrifugal accelerations in the range of +6G sub z to −3G sub z. Renal arterial pressure and inferior vena cava pressure at kidney level were measured through indwelling catheters attached to pressure transducers. Renal blood flow velocity was measured by a Doppler principle ultrasonic flow meter. The flow signal was telemetered and the pressure signals were transferred by sliprings from the centrifuge. About ten days after the sensing devices were implanted, under pentobarbital anesthesia, the experiments began for which the dogs were unanesthetized. During positive acceleration, renal blood flow velocity decreased in proportion to +G sub z to a minimum mean value of 16% of control during +6G sub z. Mean arterial pressure rose at all +G sub z levels. Author

N70-40854# Imperial Coll. of Science and Technology, London (England). Physiological Flow Studies Unit.

WALL SHEAR RATE IN ARTERIES AND DISTRIBUTION OF EARLY ATHEROMA

C. G. Carp, J. M. Fitz-Gerald, and R. C. Schroter *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 (See N70-40841 23-04) 10 p refs
Avail: NTIS

Examination of arterial fluid mechanics indicates that there will be spatial variation of wall shear; studies in model systems identify regions expected to experience high or low shear. A study of human post-mortem arterial material reveals that early atheromatous lesions are found in regions expected to experience low wall shear, while high shear regions are spared. Published reports substantiate this distribution of lesions. This correlation of early atheroma with low wall shear is inconsistent with a mechanical wall damage hypothesis. It suggests implication of shear dependent mass transfer processes. A shear dependent mass transfer process, including arterial wall synthesis of lipid, is proposed. Author

N70-40855# Nijmegen Univ. (Netherlands). Dept. of Physiology.

RESPIRATORY FLUCTUATIONS OF OXYGEN TENSION IN CENTRAL VESSELS OF THE DOG

H. Yokota and F. Kreuzer *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 (See N70-40841 23-04) 10 p refs
Avail: NTIS

Oxygen tension was continuously recorded in the aorta, pulmonary artery, and the caval veins of anesthetized dogs during spontaneous and artificial ventilation, using catheter oxygen electrodes of own design with a response time of fractions of a second. The respiratory fluctuations of the aortic oxygen tension showed a rather uniform pattern according to the course of the alveolar oxygen tension during hypoxia and normoxia. The amplitude was inversely related to the breathing frequency and increased with increasing oxygenation. The pattern with 100% oxygen breathing was different and more irregular, probably due to the influence of veno-arterial shunting since the amplitude was proportional to the alveolar-arterial oxygen pressure difference. The amplitude of the respiratory fluctuations of venous oxygen tension was smaller in the superior than in the inferior caval vein although the mean oxygen tension was higher in the superior caval vein. The pulmonary arterial fluctuations were surprisingly small. Author

N70-40856# Technische Hochschule Aachen (West Germany). Aerodynamisches Inst.

MODEL STUDIES OF PULSATING FLOW IN ARTERIAL BRANCHES AND WAVE PROPAGATION IN BLOOD VESSELS

H. Zeller, N. Talukder, and J. Lorenz *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 (See N70-40841 23-04) 10 p refs
Avail: NTIS

Steady flows through models of arterial branches at different Re-numbers show the presence of secondary spiral motion immediately behind the point of bifurcation. If the mean velocities of the flow in the two branches are different, an enclosed deadwater region is developed near the outer wall of the branch with the lower mean velocity. These two phenomena a persist even if the flow pulsates, however the rotation of the fluid in the deadwater zone becomes stronger. To simulate the propagation of waves in blood vessels tubes of different elastic wall materials have been used. Experiments with liquids in systems of rubber and PVC walls show the strong influence of the dynamic visco-elastic properties on the velocity the distortion and the damping of pulse waves. Author

N70-40857# Naples Univ. (Italy). Istituto di Aerodinamica.

MOMENTUM AND ENERGY TRANSFER IN BLOOD FLOWS THROUGH DEFORMABLE PIPES

L. G. Napolitano and G. M. Carlomagno *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 (See N70-40841 23-04) 11 p refs
Avail: NTIS

Recent advances in momentum and energy transfer in blood flows through deformable pipes have been surveyed. On the one hand attention has been focused on what it is necessary to know, and what is presently known in order to set up adequate biological

fluid-dynamics models for the blood circulation. On the other hand, a critical survey is made of what is the present status of theoretical and experimental knowledge on those basic fluid-dynamic problems which, although related to simpler and more naive models, still need to be solved. It has been shown that much experimental and theoretical work needs to be done on both the equilibrium and irreversible thermodynamics properties of the blood and the vessel walls; in particular the effective role played by the smooth muscle behavior should be definitely investigated; furthermore the need of an accurate theoretical and experimental analysis of heat transfer processes in pulsating flows, both in rigid and flexible pipes, is stressed. Author

N70-40858# Oxford Univ. (England). University Lab. of Physiology.

ARTERIAL WAVE PROPAGATION IN VIVO

F. V. Mc L. Booth *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 (See N70-40841 23-04) 8 p refs

Avail: NTIS

Measurements have been made on the transmission of short trains of sinusoidal waves of pressure, peak to peak amplitude 10-15 mm Hg and frequency 40-100 in mature greyhounds. In these experiments no significant difference on transmission grounds could be detected between the aorta and the femoral artery. Similar experiments on rubber tubing gave results which agreed with predictions from separate determinations of static and dynamic elasticity, using the Womersley expressions for the fully tethered tube as modified by Taylor for the viscoelastic case. Author

N70-40859# Oxford Univ. (England).

THE MEASUREMENT OF INSTANTANEOUS BLOOD VELOCITY AND A CALCULATION OF TOTAL MECHANICAL ENERGY EXPENDITURE IN VENTRICULAR PUMPING

D. H. Bergel, C. Clark, D. L. Schultz, and D. S. Tunstall Pedoe *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 18 p refs (See N70-40841 23-04)

Avail: NTIS

The paper describes the adaptation of thin film anemometers to the measurement of blood velocity in the major arteries of animals. Using these instruments, it has been possible to produce a rough survey of the radial velocity distribution in the ascending and descending aorta of dogs and to observe the velocity waveform in smaller branch vessels such as the brachiocephalic and coronary arteries. The instrument has more than adequate frequency response for the flow situation both in resting and exercise states and as an example of its ability to detect turbulence, some results of observations on the propagation of turbulent disturbances in the aorta and brachiocephalic artery of a dog are shown, together with observations of turbulent flow in the aorta of patients with valvular lesions. More recent research has been directed towards a study of the total mechanical energy expenditure in ventricular pumping where simultaneous measurements of the blood velocity and pressure are required. It is shown that the kinetic energy component, while normally small, may increase markedly following the administration of isoprenaline. Author

N70-40860# General Electric Co., Philadelphia, Pa. Environmental Sciences Lab.

NONLINEAR THEORY OF PULSATILE BLOOD FLOW THROUGH VISCOELASTIC BLOOD VESSELS

Paul Gordon and Sinclaire M. Scala *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul.1970 16 p refs (See N70-40841 23-04)

Avail: NTIS

In most earlier work on theoretical models for blood flow, the point of departure has been the incompressible, viscous Navier-Stokes equations. However, in the arterial vessels adjacent to the heart, there is much evidence to suggest that the flow has no time to develop a significant boundary layer. For calculating the inlet pressure rise an inviscid model based on the complete time-dependent Euler equations was formed. Demonstrated is that although the density variation is small, it is by no means insignificant; this density variation is a stable and computable function whose calculation is no more difficult than that of the other flow variables. A real difficulty with the compressible inviscid equations is that the time step that can be utilized in the calculations is governed by the quasi-steady features of the physical problem, which is discussed in detail herein. A series of results based on our computations is presented, and the effects of wall elasticity, downstream bifurcations and tethering points on left ventricular pressure are discussed. Author

N70-40861# Case Western Reserve Univ., Cleveland, Ohio. Div. of Fluid, Thermal, and Aerospace Sciences.

SIMULATION OF VASCULAR DYNAMICS AND MEASURED FLOW CHARACTERISTICS

Simon Ostrach, B. H. Ruterbories, and P. H. Hepner *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 9 p refs (See N70-40841 23-04)

Avail: NTIS

The dimensionless parameters that describe the pulsating flow of an incompressible fluid in a distensible tube are derived. Evaluation of these parameters from the physiologic data for the macrocirculation indicates that three are most significant for flow in the great vessels. These are: (1) an unsteadiness parameter; (2) the Reynolds number; and (3) a flexibility parameter (which indicates the ratio of wall elastic to fluid pressure forces). On the basis of the three significant parameters an experimental apparatus was designed to operate over the range of values of these parameters that correspond to normal and pathological conditions in a portion of the human cardiovascular system. It was determined that the dimensionless parameters derived are the significant ones and the data correlates well with their use. Peaking of the pressure profiles and the appearance of a dicrotic arch, two phenomena that are observed in the circulatory system, were also obtained in the experiments and some insight is obtained of the conditions of their occurrence. Author

N70-40862*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

THEORETICAL ANALYSIS OF NONLINEAR PHENOMENA AFFECTING THE PRESSURE AND FLOW PULSE IN ARTERIES

Max Anliker, Robert Rockwell (Naval Weapons Center), and Eric Ogden (NASA, Ames Res. Center) *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 12 p refs (See N70-40841 23-04)

(Grant NGL-05-020-223)

Avail: NTIS CSCL 06P

As part of a systematic effort to develop noninvasive methods of measuring the deconditioning of the cardiovascular system of astronauts during space flights of long duration, studies have been initiated on the effects of various system parameters on the pressure and flow pulses in arteries. To examine the significance of the nonlinear effects associated with the variation of the wave speed with pressure and flow and with the large local changes in the cross-sectional area of the blood vessel which may be of the order of 20 to 50%, the method of characteristics was used to solve the one-dimensional equations of incompressible viscous flow. The artery was modeled geometrically in the form of a tube segment whose radius decreases in a prescribed fashion with distance from the heart at a given mean pressure; the effect of discrete branches was simulated by a continuously distributed outflow. Full advantage was taken of available experimental data in specifying the mechanical properties of the vessel wall through the local speed of propagation of small signals and its pressure

dependence. As boundary condition at the proximal end the ejection pattern into the aorta was prescribed, while at the distal end a constant terminal pressure was specified. The nonlinear phenomena considered have a marked influence on the pressure and flow patterns. For pressure signals of sufficiently large initial amplitude shock waves develop within a relatively short distance from the heart. Author

N70-40863# Queen Elizabeth Hospital, Birmingham (England).
MORPHOLOGICAL ASPECTS OF THE PULMONARY CIRCULATION AND OF THE AIRWAYS
G. Cumming, L. K. Harding, K. Horsfield, K. Prowse, S. S. Singhal, and M. Woldenberg *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 8 p refs (See N70-40841 23-04)
Avail: NTIS

The quantitative morphometry of the pulmonary artery and the bronchial tree in the human has been studied using combined techniques of plastic corrosion specimens, thick sections and scanning electron microscopy. All large structures in both branching systems have been uniquely identified and measured, the data being recorded on computer cards and magnetic tape. A variety of methods for describing branching systems has been used, and from these a mathematical expression for the number of branches arising from each parent branch has been derived. The ratio of diameters and lengths of successive branches is also expressed in mathematical form. The information is summarized. Author

N70-40864# Paris Univ. (France). Dept. de Physiologie.
INDIRECT STUDY OF THE PATTERN OF FLOW IN THE HUMAN AIR PASSAGES
D. Bargeton, M. Cousin, G. Danon, E. Florentin, and A. Teillac *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 12 p refs (See N70-40841 23-04)
Avail: NTIS

The changes of partial pressures in the expired gas of carbon dioxide and of oxygen are due to propagation to the mouth of the changes of the composition of alveolar gas during the respiratory cycle and mixing of the alveolar gas with dead space air. Observation of the expired gas at the mouth gives indirect information upon the pattern of flow in the upper air passages. It is shown that: (1) the pattern of flow in the upper airways is intermediary between the Poiseuille and the Prandtl types; (2) an index of turbulence gamma can be fitted to the data giving the situation of the actual pattern of flow between these two theoretical limits; (3) gamma is expected to increase with conditions which increase turbulence; and (4) model experiments and observations in man at rest and at moderate exercise shows that gamma increases linearly with the mean velocity of flow, and gamma increases with the density of the gas, if N sub 2 in the inspired is replaced by SF sub 6 or Xe. Author

N70-40865# Medical Research Council, London (England). London School of Hygiene and Tropical Medicine.
THE USE OF AEROSOLS TO INTERPRET THE FUNCTIONING IN THE HUMAN LUNGS
C. N. Davies, J. Heyder (Ges. fuer Strahlenforsch.), and M. C. Subba Ramu (Bhabha Atomic Res. Centre) *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 7 p refs (See N70-40841 23-04)
Avail: NTIS

Attention has been given to increasing the consistency of continuous measurements of the exhaled concentration of aerosol containing 0.5 micrometers diameter particles of di-ethyl-hexl sebacate during steady breathing, single breath inhalation and other respiratory maneuvres. When breathing steadily, at a controlled frequency and amplitude, it has been found that aerosol deposition depends on the expiratory reserve volume; this has been studied by measuring the subject's deep exhalation after breathing aerosol. The recovery of aerosol from the lungs, after a number of breaths and after a single breath, has been measured both by changing over to pure air and by deep exhalation; it also depends on the resting expiratory level. From the experimental data it is possible to estimate the surface area and volume of the alveoli at different resting respiratory levels. It is shown that 0.5 micrometer particles remain airborne in the residual air during several breaths before depositing on the alveolar walls. Author

N70-40866# Naval Medical Research Inst., Bethesda, Md.
THE ROLE OF HEMODYNAMICS IN THE TRANSPORT OF INERT GASES IN THE PERIPHERAL CIRCULATION
Richaed G. Buckles *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 10 p refs (See N70-40841 23-04)
Avail: NTIS

Decompression sickness, which afflicts both fliers and divers, occurs primarily because the body is unable to rid itself of excess dissolved inert gas when subjected to a reduction in hydrostatic pressure. The inert gas leaves principally through the lungs, being carried there from the peripheral tissues by the blood. In peripheral regions such as skin, cartilage, bone, and connective tissue the anatomy strongly suggests that diffusion will play a role in defining inert gas exchange. Such factors as intercapillary separations and counter current arterio-venous diffusive exchange are dramatically different in these tissues. In addition, most of the peripheral tissues are sensitive to environmental factors such as temperature, pressure, and O2 pressure in a fashion unlike the central tissues. A series of studies will show the actual dynamics of Kr85 exchange in the pouch of a hamster when it is attached to a closed breathing loop filled with air and Kr85. Uptake and washout are monitored in order to assess the relative roles of perfusion and diffusion. Author

N70-40867# Imperial Coll. of Science and Technology, London (England). Physiological Flow Studies Unit.
A THEORY FOR GAS MIXING IN A SIMPLE MODEL OF THE LUNG
T. J. Pedley *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 7 p refs (See N70-40841 23-04)
Avail: NTIS

The object of this theory is to assess the importance, for example on the slope of the alveolar plateau in single breath N2 washout experiments, of the mixing which a gas undergoes as it is being inspired or expired. Regional variations are ignored, and the lung is approximated by a single tube whose cross-sectional area increases with distance x from the trachea. Gas concentrations are assumed to be uniform across this tube, and the mixing process is described by an effective diffusivity which varies continuously from the Taylor value for turbulent flow in the trachea to the molecular value at the alveolar end. Inspiratory and expiratory velocities are assumed to be independent of time, and the governing equation is a one-dimensional diffusion equation with x-dependent coefficients. This equation is solved, subject to appropriate boundary and initial conditions, by means of an eigenfunction expansion. Some preliminary numerical results for the eigenvalues are presented. Author

N70-40868# Imperial Coll. of Science and Technology, London (England). Physiological Flow Studies Unit.
REVIEW OF THE EUROMECH 12 COLLOQUIUM ON FLUID MECHANICS OF CIRCULATION AND RESPIRATION
C. G. Caro *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 3 p Colloq. held at Jablonna, Poland, 8 – 11 Sep. 1969 (See N70-40841 23-04)
Avail: NTIS

Topics discussed under microcirculation included the distribution of blood pressure within the arterial system and diffusion and convection in capillaries. There was particular interest in studies of the motion of the flexible red cells in capillaries and of

the plasma between these cells. Contributions under respiration included pressure and flow in the trachea, flow patterns in branched tubes, the pressure drop in the bronchial airways, and experimental and theoretical studies on or related to the behaviour of inhaled particles. The section on large vessels and the heart included wave propagation in elastic tubes, the origin of sound within the circulation and the effect of turbulence on the arterial wall. Papers on techniques indicate that prospects exist for the making of important new measurements. Moreover the techniques and the information they promise may become interesting areas for analysis.
Author

N70-40869# Nijmegen Univ. (Netherlands). Dept. of Physiology.
FACILITATED DIFFUSION OF OXYGEN IN THE PRESENCE OF HEMOGLOBIN AND MYOGLOBIN
F. Kreuzer and L. J. C. Hoofd *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 7 p refs (See N70-40841 23-04)
Avail: NTIS

The possible facilitation of oxygen diffusion by hemoglobin or myoglobin has attracted increasing interest in recent years. A quantitative description of the experimental results was not obtained hitherto. Developed was an approximate solution for the basic diffusion equations including the chemical reactions between oxygen and hemoglobin or myoglobin and the resulting expressions were applied to numerical computer solutions. The most important physical data were collected and critically evaluated, particularly the diffusion coefficients of hemoglobin and myoglobin as a function of protein concentration. Using these data the facilitated oxygen fluxes were computed for hemoglobin and myoglobin as a function of protein concentration. The agreement with experimental values was excellent for hemoglobin, but the computed curves tended to be too high when compared with experimental points in the case of myoglobin. The influence of the magnitude of the oxymyoglobin dissociation velocity constant was therefore also examined.
Author

N70-40870# Texas A&M Univ., College Station.
ANALYSIS OF THE DYNAMIC RESPONSE OF SUSPENDED PARTICLES IN A FLOWING NEWTONIAN FLUID MATRIX
Paul H. Newell, Jr. and Danial G. Barbee *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 8 p refs (See N70-40841 23-04)
Avail: NTIS

The trajectories of dilute suspensions of rigid, spherical particles were calculated from developing, axial and radial fluid velocity profiles determined from a numerical analysis of the boundary layer equations for an undisturbed flow in rigid tubes. The forces on the particles were evaluated from a Stokes formulation based upon relative velocities. Fluid streamlines and particle pathlines are presented for a flow developing from an initial slug-profile. Attention is called to the need to report detailed particle injection procedures and to be more cognizant of entrance effects in future experimental investigations into suspended flows. Finally a model is suggested which will provide for the theoretical quantification of the tubular pinch effect.
Author

N70-40871# Toulouse Univ. (France). Lab. d'Applications de Radioelements.
CEREBRAL BLOOD FLOW AND THE CHOICE OF RADIOACTIVE INDICATORS (METHODS AND MEANS) [LE DEBIT SANGUIN CEREBRAL ET LE CHOIX DES INDICATEURS RADIO-ACTIFS (METHODES ET MOYENS)]
M. C. Curie and J. P. Marc-Vergnes *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 9 p refs In FRENCH (See N70-40841 23-04)
Avail: NTIS

The measurement of cerebral flows can be distinguished by two methods, one using inert gases, allowing the conditions of cerebral tissue saturation to be seen, and the other using products which do not cross the parenchyma, enabling the study of the behavior of the vascular bed. The relationships between these flows permit the measurement of the weight of the brain.
Transl. by P.A.B.

N70-40893*# Naval Medical Research Inst., Bethesda, Md. Dept. of Microbiology.
EFFECTS OF HIGH AND LOW BAROMETRIC PRESSURES ON SUSCEPTIBILITY AND RESISTANCE TO INFECTION Quarterly Status Report, 1 Apr. – 30 Jun. 1970
Francis B. Gordon, James D. Gillmore, Eugene Zebovitz, and Sheila Bond 30 Jun. 1970 12 p refs
(NASA Order A-3061A-(AS-1); NASA Order L-97; NASA Order L-464; NASA Order R-21-010-010)
(NASA-CR-113639; QSR-20) Avail: NTIS CSCL 06E

The problem of maintaining the body temperature of small experimental animals in a helium atmosphere, and an analysis of the significance of a lowered body temperature in susceptibility to influenza viral infection are investigated. Maintenace of the gas phase (1% O2 in He, 500 psig) at 35 C enabled mice to preserve a body temperature within 2–3 C of normal. Additional experiments point toward an adverse effect of a normoxic O2-He atmosphere, at normal or incressed barometric (95 psig) pressures; even when the temperature of the gas phase is raised to a point (30 C) that enables mice to maintain a normal, or nearly normal, body temperature. An experiment utilizing 11% O2 in N2 at one atmosphere for exposure of mice following inoculation with Coxsackie virus has confirmed the earlier observation of a more severe infection due to hypoxia as provided by an atmosphere of air at 7.3 psia. Although definitive tests on the incidence of transformation in altered atmospheres are not yet complete, an increased resistance of transformed cells to O2 toxicity was observed.
Author

N70-40920 National Lending Library for Science and Technology, Boston Spa (England).
RECOMMENDATIONS FOR THE CALCULATION OF DISPERSION IN THE ATMOSPHERE OF NOXIOUS AGENTS (DUST AND SULPHUR DIOXIDE), CONTAINED IN THE EFFLUENTS FROM INDUSTRIAL UNDERTAKINGS
22 Jun. 1970 49 p Transl. into ENGLISH from Gidromet. Izdat. (Leningrad), 1967 49 p
(NLL-CE-Trans-5184-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 5 NLL photocopy coupons

The recommendations set out a procedure for calculating dispersion in the atmosphere of dust and sulphur dioxide discharged to atmosphere by industrial installations and boiler plants. Single sources and groups of sources of emission are considered, and recommendations are given for: taking into account the background pollution of the air basin of a residential area; determination of the boundaries of the health protection zone; and undertaking basic measures for protecting the air basin from pollution with the operation of industrial installations and boiler plants.
Author

N70-40942# Army Edgewood Arsenal, Md.
INHIBITION OF SWEATING BY SALTS OF HYOSCINE AND HYOSCYAMINE
F. N. Craig Jul. 1970 25 p refs
(AD-709622; EA-TR-4411) Avail: NTIS CSCL 6/15

In tests of the inhibitory effect on sweating of optical isomers of hyoscyamine camphor sulfonate in one man, the levorotatory isomer was about 70 times more active than the dextrorotatory isomer. There was no significant difference in effect of equimolar doses of the levorotatory isomer and of atropine sulfate. Weight loss, body temperature, and heart rate were recorded for several hours on eight resting men at 41 and 52C. At 41C, seven men received intravenous injections of atropine sulfate and scopolamine

hydrobromide, four men received atropine methylnitrate and the remaining four men received methscopolamine bromide. The doses were equimolar for the active base. The quaternary salts atropine methylnitrate and methscopolamine bromide were between two and three times more potent than the tertiary salts atropine sulfate and scopolam amine hydrobromide. The hyoscyamine salts were indistinguishable from the hyoscine salts with respect to inhibition of sweating and elevation of heart rate and skin and rectal temperatures. Because the salts differ widely in their potency in the central nervous system, the similarity of their peripheral actions supports the view that the action of low doses of atropine on temperature regulation is mainly peripheral. Author (TAB)

N70-40946# Texas Univ., Houston. Graduate School of Biomedical Sciences.
THE EFFECTS OF LASER RADIATION ON RECEPTOR FUNCTION IN HUMAN AND PRIMATE EYES Annual Progress Report, 1 Jun. 1969 – 1 Apr. 1970
Harry G. Sperling, Ronald S. Harwerth, John H. Mabry, and Clement Johnson 8 May 1970 47 p refs
(Contract DADA17-67-C-7154)
(AD-709655; UT-GSBS-DADA-3; APR-3) Avail: NTIS CSCL 6/5

In a series of experiments, the effects of intense spectral bands having the characteristics of ruby and argon laser light were measured in rhesus monkey eyes. Results obtained by measuring spectral sensitivity in their presence - or immediately after these exposures - demand a two-stage (receptor stage, neural opponent stage) explanation of spectral sensitivity for the highly light adapted eye. In continuing studies, these measures are being carried over the entire range up to intensities of laser light which will produce gross thermal injury. It is planned to relate changes in visual sensitivity to ultrastructural changes in the retina. The techniques for ultrastructural study of the vertebrate retina are briefly discussed. Author (TAB)

N70-40949*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.
EXPERIMENTALLY DERIVED EXPLANATIONS OF SOME ASPECTS OF THE ORIGIN OF LIFE
Sidney W. Fox May 1969 34 p refs *Its* Contrib. No. 137
(Contract NAS9-8101; GRANT NGR-10-007-008)
(NASA-CR-113795) Avail: NTIS CSCL 06C

Research is reported aimed at obtaining answers to the fundamental questions of how enzymes began in the absence of enzymes, of how cells arose in the absence of cells, and of how genes appeared in the absence of genes. Experimentation discussed deals with models of the origin of energy transfer mechanisms, internal synthesis of peptide bonds, and origin of the genetic code. Based on the results of these experiments, explanations are offered as to the origin of enzymes, metabolism, order in proteins, cells, membranes, and reproduction. D.L.G.

N70-41065# Columbia Univ., N.Y. Psychophysics Lab.
BEHAVIORAL DEFINITION OF MINIMAL REACTION TIME IN MONKEYS
Carol A. Saslow 1 Mar. 1970 51 p refs Prepared in cooperation with Wash. Univ., Seattle.
(Contract N00014-67-A-0108-0005; Grants PHS-FR-00166; PHS-GM-66-08)
(AD-709081; PLR-12) Avail: NTIS CSCL 5/10

Two monkeys (M. mulatta) were trained to press a telegraph key after onset of a tone and to release it after a fixed foreperiod of 1 sec ended by a light flash (SD). To be reinforced, the response had to fall within a payoff band, with two limits 50 msec. apart, located at some interval after SD. The payoff band was moved toward SD in a gradually descending series and then returned to longer intervals in an ascending series while medians and semi-interquartile ranges (SIQRs) were determined from latency distributions for each band. A simple RT model suggested that latency distributions could be composed of a combination of high-variability foreperiod time estimations, low-variability minimal RTs or responses timed from SD. The SIQR, according to the model, would increase rapidly when the animal included foreperiod estimation in his latency distribution to meet a fast band location. Minimal RT was defined as the fastest the animal would go before beginning to inflate his variability and decrease his reinforcements by foreperiod estimations. The predictions of the model were confirmed. The results are used to evaluate the interpretation of RT as a scaling measure of subjective intensity. Author (TAB)

N70-41072*# Becton, Dickinson and Co., Rutherford, N.J.
PRELIMINARY SUBLIMATION STUDIES
J. J. Tulis and H. S. Lilja 14 Feb. 1969 9 p
(Contract NASw-1764)
(NASA-CR-113856; TR-4) Avail: NTIS CSCL 06M

Preliminary studies were performed to determine whether viable microorganisms are released from the frozen state, when in an aqueous menstruum, upon sublimation. Data indicated that small numbers of viable bacterial spores are released from a frozen aqueous suspension and could thereby contaminate outer space. However, when microorganisms contained in skim milk were frozen and subsequently exposed to high vacuum, the process of sublimation was not associated with microbial transfer, whether using bacterial spores or vegetative cells. Thus, the residual protein matrix resulting from the sublimation process, when using skim milk, may provide a structure that contains the microorganisms and prevents their release. It is recommended that further studies be performed using a prototype of the Apollo sublimation apparatus. Author

N70-41108# RAND Corp., New York.
FACE RECOGNITION: A SPECIAL PROCESS?
Robert K. Yin Jul. 1970 26 p refs
(AD-709624; P-4419) Avail: NTIS CSCL 5/10

Four experiments analyzed the ability to distinguish and remember faces by comparing face and object recognition under several conditions. First, memory was tested for correctly oriented pictures and inverted ones. Second, it was tested for pictures presented for long and brief exposures. Third, subjects described pictures and later re-matched their own descriptions with the same pictures. Fourth, people with different brain injuries performed on a shorter version of the upright-inverted memory tests. In each of these cases, face recognition was different from object recognition, providing some evidence that face recognition may involve a face-specific process. Author (TAB)

N70-41110*# Sandia Corp., Albuquerque, N. Mex. Planetary Quarantine Systems Studies Div.
DRY-HEAT STERILIZATION MODELING Interim Report
J. P. Brannen Aug. 1970 103 p refs Sponsored in part by AEC
(NASA Order N-12853)
(NASA-CR-113817; SC-PR-70-439) Avail: NTIS CSCL 06M

A rational model for spacecraft dry-heat sterilization is considered based on the following assumptions: (1) Microorganisms are independently sterilized, i.e., the sterilization of a particular organism has no effect on the sterilization of another. (2) In a thermal environment, sterilization is the consequence of chemical reactions. (3) These reactions have order. (4) There may be several competing mechanisms involved in sterilization. Model generalization and analyses for both microbial water activity and pressure are included. The results show that DNA denaturation is responsible for wet-heat sterilization of Bacillus subtilis. It is concluded that the inclusion of water activity is accomplished in a kinetic sterilization model by means of absolute reaction-rate theory and the entropy of activation, and from a kinetic viewpoint, there is little difference

between experiments run at a pressure of 0.000001 torr and 10 to the minus 17th power torr. Consequently, experiments run at 0.000001 torr are adequate for kinetic sterilization prediction related to an outer space environment. F.O.S.

N70-41163*# Food and Drug Administration, Cincinnati, Ohio. Div. of Microbiology.

ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Quarterly Progress Report, 1 Apr. – 30 Jun. 1970

R. B. Read, Jr. Sep. 1970 9 p ref

(NASA Order R-36-015-001)

(NASA-CR-113870; QPR-21) Avail: NTIS CSCL 06M

Experiments were conducted, involving thousands of spore populations, to identify the nature of the thermal inactivation curve of B. subtilis var. niger spores under 2.6, 10, and 100 micrograms of water per ml of headspace air. The spores were suspended in 95% ethyl alcohol, diluted in sterile double distilled water, and dispensed in 0.01 ml amounts into stainless steel cups to give about 1 million spores per cup. The cups were placed in tin cans and dried in a vacuum oven for 90 minutes at 46 to 50 C at 1.5 inch Hg pressure. Spore survivors from cups containing less than 10 spores per cup were assayed by sonifying the cups in peptone water and plating. Cups were scored for growth or no growth and the most probable numbers of survivors per cup calculated from these data. Typical thermal inactivation curves are given. D.L.G.

N70-41220# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.

PHYSIOLOGICALLY TOLERABLE DECOMPRESSION PROFILES FOR SUPERSONIC TRANSPORT TYPE CERTIFICATION

Stanley R. Mohler Jul. 1970 16 p refs

(AM-70-12) Avail: NTIS

The supersonic transport represents a quantum step in civil aeronautics. It will cruise at altitudes having low ambient gaseous pressures far exceeding human capacities for compensatory respiration. In consideration of this evolutionary step, tentative airworthiness standards with respect to SST pressurization capabilities in the event of depressurization emergencies are discussed and a series of evolved SST cabin altitude-time profiles, together with the basis of their development, are than presented. Author

N70-41221# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.

PILOT HEART RATE DURING IN-FLIGHT SIMULATED INSTRUMENT APPROACHES IN A GENERAL AIRCRAFT

A. Howard Hasbrook and Paul G. Rasmussen Apr. 1970 14 p refs

(AM-70-7) Avail: NTIS

Eight instrument rated pilots with flying experience ranging from 600 to 12,271 hours each flew 10 simulated ILS instrument approaches in a single engine, general aviation aircraft equipped with a primary flight display arranged in a conventional configuration. Continuous heart rate data were recorded during each approach. Approaches were flown consecutively at approximate 10 minute intervals, with a 1 minute in-flight rest period prior to each approach. Principal findings were: heart rate increased significantly during each approach; mean increase in heart rate during the approaches was 5.2 beats per minute (BPM) and was of a relatively constant magnitude for each of the 10 approaches; and the overall mean heart rate level decreased on successive approaches for a total of 11.0 BPM for the 10 approaches. The results are discussed in terms of responses to stress introduced by the demands of the task. Author

N70-41223*# Stanford Univ., Calif., Cardiology Div.

EVALUATION OF THE CARDIOVASCULAR SYSTEM DURING VARIOUS CIRCULATORY STRESSES Progress Report, 1 Jun. 1969 – 30 May 1970

Donald C. Harrison 30 May 1970 29 p refs

(GRANT NGR-05-020-305)

(NASA-CR-113933) Avail: NTIS CSCL 06C

Dopamine, lidocaine, and morphine studies with an animal myocardial infarction model were completed. Preliminary results are given for further animal studies concerning the effects of digitalis glyosides in experimental myocardial infarction, an evaluation of factors which relate to measurement of the left ventricular dp/dt, multiple flow transducer utilization for recording the distribution of cardiac output, and the circulatory effects of myocardial infarction in unanesthetized dogs. Progress in human studies is reported for ultrasound research, pressure transducer testing, fiber optics studies, and work concerning the dynamic geometry of the left ventricle. Proposed studies are summarized, and a bibliography listing abstracts, manuscripts, and presentations resulting from the research is included. P.A.B.

N70-41224*# Standard Univ., Calif. Medical Center.

GLC OF SERUM PHENYLALANINE: A GAS LIQUID CHROMATOGRAPHIC METHOD FOR THE DETERMINATION OF PHENYLALANINE SERUM

E. Jellum, V. A. Close, W. Patton, W. Pereira, B. Halpern, et al [1970] 17 p refs Supported in part by the Norweg. Cancer Soc.

(Grant NGR-05-020-004)

(NASA-CR-113875) Avail: NTIS CSCL 06A

A rapid, specific, and precise gas liquid chromatographic method is described for the quantitative determination of phenylalanine in serum. The method is based on the conversion of the amino acid to the volatile neopentylidene phenylalanine methyl ester derivative. It is useful as a confirmatory test in diagnosis of suspected phenylketonuria and in evaluating the affectiveness of a diet low in phenylalanine. Author

N70-41225*# Florida State Univ., Tallahassee.

BIOSTATISTICS OF SPACE EXPLORATION: MICROBIOLOGY AND STERILIZATION Final Report, 1 Sep. 1965 – 1 Sep. 1970

Richard G. Cornell 15 Sep. 1970 6 p refs

(Grant NGR-10-004-029)

(NASA-CR-113863) Avail: NTIS CSCL 06M

Statistical problems related to investigations on the decontamination of spacecraft and related studies of microbial life are discussed. The research is divided into three categories of spacecraft sterilization probability models, statistical procedures for microbial assays and related nonlinear regression problems, and statistical procedures of general usage. R.B.

N70-41274*# Florida State Univ., Tallahassee. Dept. of Statistics.

EXPONENTIAL DECONTAMINATION MODELS FOR COUNT DATA

Richard G. Cornell and Ashok K. Bansal 1 Sep. 1970 19 p refs

(Grant NGR-10-004-029)

(NASA-CR-113861; TR-22) Avail: NTIS CSCL 06T

Several models are developed for the estimation of the rate of exponential die-off from decontamination data. Calculations with illustrative data are reported which indicate that the estimation of this rate and its variance are sensitive to changes in modelling assumptions. Since extrapolation using this estimated rate is used in the specification of planetary quarantine standards, special care should be taken in the selection of an appropriate model and corresponding estimation procedure for the analysis of each set of decontamination data to be used for this purpose. Author

N70-41327# Rowland and Co., Haddonfield, N.J.
VISUAL ILLUSION PROBLEMS Final Report
George E. Rowland and Joseph F. Snyder Sep. 1970 94 p refs
(Contract DOT-FA69NA-357)
(FAA-NA-69-42; FAA-RD-69-49) Avail: NTIS

A literature search was made concerning purely visual illusions which might originate from lighting or marking of aircraft and which might induce pilots to become involved in near-misses or collisions. (The study specifically avoided vestibular-induced illusions.) Areas were identified that are capable of causing illusions to pilots, including the geometrical illusion; aftereffects, with particular reference to figural after-effects; hypnogogic hallucinations; expectancy (or mental set) and unexpected events; interactions between kinesthetic and visual stimuli; and personality variables in response to after-effects and illusions. Recommendations are made for a wide variety of researches, but specific attention is drawn to improvements in the way pilots are taught to utilize their visual sense and research on after-images and figural after-effects. These two effects hold some likelihood of being a serious source of illusory perception to pilots. In general, further research in illusions should be quite limited since the effects they create are probably not causing much trouble. A small research program on figural after-effects is recommended. Author

N70-41334*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A NONEQUILIBRIUM THERMODYNAMIC MODEL OF ION TRANSPORT IN A THREE-COMPARTMENT SYSTEM
Heinz George Hausch (Ph.D. Thesis—Med. Coll. of Virginia) Jun. 1970 129 p refs
(NASA-TM-X-66345) Avail: NTIS CSCL 06C

A physical analog of steady-state sodium and potassium transport in a two-membrane, three-compartment system was studied utilizing the principles of nonequilibrium thermodynamics. This physical system is analogous to physiological systems where one compartment consisting of a cell monolayer separates two other compartments, such as the interstitial fluid and the renal tubule lumen in the kidney. The phenomenological equations relating the flows through the membranes to the chemical potential gradients were developed from the equation for energy dissipation within each membrane. The flows defined both the nonsteady-state rates of change of concentrations within each compartment and the steady-state transport across each membrane. Ion transport due to chemical convection was studied by adding water to the cell compartment and removing it from the interstitial compartment. The lumen compartment was left as a strictly passive compartment. The Na(+), K(+), and Cl(−) concentrations were measured periodically until a steady-state was reached. Author

N70-41385# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
RESEARCH ON THE ELEMENT AND ISOTOPE DISCRIMINATION OF ALKALIS ON MEMBRANES OF UNICELLULAR ALGAE [UNTERSUCHUNG UEBER DIE ELEMENT- UND ISOTOPEN- DISKRIMINIERUNG VON ALKALIIONEN AN MEMBRANEN EINZELLIGER ALGEN]
Ulrich Zimmermann (Ph.D. Thesis) 1968 73 p refs In GERMAN Avail: NTIS

The effects of alkali elements and isotopes on the membranes of unicellular algae are discussed. The chemical and physical properties of algae immersed in various concentrations of alkali solutions are presented. Mass spectroscopy and radiometry techniques are used to determine the effects. The results of the research are presented in tables and graphs. Transl. by P.N.F.

N70-41454*# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF SPACECRAFT MATERIALS THAT SUPPORT MICROORGANISM GROWTH
H. T. Kemp and C. W. Cooper 17 Jun. 1970 51 p refs
(Contract NAS8-30504)
(NASA-CR-113798) Avail: NTIS CSCL 06M

Seventeen externally applied spacecraft paint coatings were selected from a literature survey and evaluated in laboratory studies for growth supporting or biocidal properties using representative bacteria and fungi strains. Extract, petri plate, high humidity, and soil burial experiments were carried out. None of the coatings totally inhibited test organisms and few were highly resistant to microbial deterioration. The best coatings were varnish, phenolic-butyrate, and polyimide. E.C.

N70-41463# Joint Publications Research Service, Washington, D.C.
INTELLECT, COGNITION, AND TECHNOLOGY
Yevgeniy Semenovich 15 Sep. 1970 48 p Transl. into ENGLISH of the booklet 'Intellekt, Poznaniye, Tekhnika' Moscow, Znaniye, 1970
(JPRS-51372) Avail: NTIS

The heuristic quality, creativity, mobility, and prediction ability of an individual's intellect are discussed as well as his reasoning power, independence of reflection, intellectual openness, self-reflection, inclinations, dissatisfaction, and optimism. The dread of newness and conformism is also mentioned. The principles of compatibility, correspondence, permanentness, and scientific equality and superiority are included under collective intellect along with the right to make mistakes, criticism, and the principles of encouragement, permanentness of the research cycle, and minimal control. J.M.

N70-41627# Harvard Univ., Boston, Mass. Medical School.
[SPATIO-TEMPORAL FACTORS IN VISUAL PERCEPTION] Final Report, 1 Jun. 1967 – 30 Jun. 1970
David N. Lee 1970 25 p refs
(Contract Nonr-1866(52))
(AD-709457) Avail: NTIS CSCL 6/16

A program of studies on the psychological and physiological changes that take place in the human organism exposed to a restricted and systematically varied perceptual field, is presented. TAB

N70-41645# Laboratory for Research in Neuropsychology, Inc., Boston, Mass.
THE ROLE OF THE PINNA IN SPEECH INTELLIGIBILITY Final Report, 15 Apr. 1969 – 14 Apr. 1970
Sanford J. Freedman May 1970 19 p refs
(Contract F44620-69-C-0064)
(AD-709712; AFOSR-70-2043TR) Avail: NTIS CSCL 17/2

Nine normal-hearing subjects listening through earphones were required to identify spoken words in a noisy background. Acoustic stimulation was picked up alternately by bare microphones and by microphones equipped with casts of human external ears (pinnae). Test scores and subjective impressions both indicated a highly significant and consistent superiority for the pinna condition. Sound level measurements and sonograms confirmed the superiority of the pinna condition. Author (TAB)

N70-41710# Naval Submarine Medical Center, Groton, Conn. Medical Research Lab.
UNDERWATER HEARING IN MAN. 2: A COMPARISON OF TEMPORARY THRESHOLD SHIFTS INDUCED BY 3500 Hz TONES IN AIR AND UNDERWATER Interim Report
Paul F. Smith, Robert Howard, Martin Harris, and Day Waterman 15 Jan. 1970 11 p refs
(AD-709550; SMRL-608) Avail: NTIS CSCL 6/16

An experiment was undertaken to explore the upper intensity limit of useful underwater hearing by comparing Temporary

Threshold Shifts (TTS) produced by exposure to intense underwater signals with TTS produced by comparable stimuli in air. Author (TAB)

N70-41712# New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.
[NEUTRON ACTIVATION ANALYSIS] Annual Report, 1 May 1969 - 30 Apr. 1970
Constantine J. Maletskos 30 Apr. 1970 81 p refs
(Contract AT(30-1)-3778)
(NYO-3778-9; PR-4) Avail: NTIS

Further studies were made of the method of removing specific interferences from activated samples by a heterogeneous isotopic exchange reaction in a column using an organic solvent for elution. Sample handling procedures and other operations related to sampling and sample handling, irradiation, and measurement were studied. In particular, the work includes an assessment of tissue contamination when using scalpels for sample cutting, the cleaning of polyethylene vials using a small ball mill and compared to ultrasonic cleaning, methods of griding salts for separation columns, and flux mapping in the irradiation containers. Tissue analyses on normal uterine muscle and fibroids growing in it are described. Uses of tissue results are considered from a statistical standpoint. Computer programs are described briefly. Some preliminary experiments on in vivo activation of rats using the slow neutron beam in the Medical Therapy Room, Massachusetts Institute of Technology Reactor, are described. Measurements were made both with Na(Tl) and Ge(Li) detectors. The results show that such activation of small animals is quite feasible. Author (NSA)

N70-41768# Congress. Senate. Committee on Public Works.
AIR POLLUTION: 1970, PART 1 From the Subcommittee on Air and Water Pollution
Washington GPO 1970 451 p refs Hearings on S. 3229, S. 3466, and S. 3546 before Comm. on Public Works, 91st Congr., 2d Sess., 16 - 18 Mar. 1970
Avail: SOD $1.75

Senate bills to amend the Clean Air Act are presented and their provisions discussed and compared. Information is provided concerning such areas as sulfur oxide pollution, fossil fuel combustiion, and the inadvertent modification of the atmosphere by air pollution. The air pollution control law of West Virginia is reprinted. Answers by HEW to questions concerning air quality criteria, control technology and development, automotive emission control, fuel additives, noise pollution, standards and enforcement, and government expenditures are supplied. P.A.B.

N70-41769# Congress. Senate. Committee on Public Works.
AIR POLLUTION: 1970, PART 2 From the Subcommittee on Air and Water Pollution
Washington GPO 1970 318 p refs Hearings on S. 3229, S. 3466, and S. 3546 before Comm. on Public Works, 91st Congr. 2d Sess., 19, 20, and 23 Mar. 1970
Avail: SOD $1.50

Information is provided and discussed on an exhaust manifold reactor to reduce exhaust emissions, air quality criteria for lead, current medical developments in lead research, and photoreactivity of trichloroethylene. Copies of briefs concerning DDT litigation are included. P.A.B.

N70-41770# Congress. Senate. Committee on Public Works.
AIR POLLUTION: 1970, PART 3
Washington GPO 1970 294 p refs Joint hearings on S. 3229, S. 3466, and S. 3546 before Comm. on Public Works and Comm. on Com., 91st Congr., 2d Sess., 24 - 25 Mar. 1970 Prepared by Subcomm. on Air and Water Pollution of the Comm. on Public Works and the Comm. on Com.
Avail: SOD $1.25

Noise pollution, its effects on man and animals, and possible abatement legislation are discussed. Other topics include wheat for motor fuel, airline antipollution measures, automobile exhaust emission and the position of the auto industry, the effect of gasoline composition and associated research and development, and toxicological problems associated with lead. P.A.B.

N70-41771# Congress. Senate. Committee on Public Works.
AIR POLLUTION: 1970, PART 4 From the Subcommittee on Air and Water Pollution
Washington GPO 1970 300 p refs Hearings on S. 3229, S. 3466, and S. 3546 before Comm. on Public Works, 91st Congr., 2d Sess., 26 Mar., 17 Apr., and 27 May 1970; also in Los Angeles, 1 Apr.
Avail: SOD $1.50

Information on California air basins, standards for exhaust emissions, and ambient air quality standards is presented. National air quality standards are then discussed, including automobile emission reduction, industrial processes, metropolitan areas, and the proposed amendments to the Clean Air Act. Data are presented on the ability of gas additives to clean engines and reduce exhaust emissions, and on specific research concerning the effects of the Chevron F-310 gas additive package. Methods to prevent and control air pollution build-up are described, and the guidelines for air pollution planning grants are presented. P.A.B.

N70-41772# Congress. Senate. Committee on Public Works.
AIR POLLUTION: 1970, PART 5: APPENDIX From the Subcommittee on Air and Water Pollution
Washington GPO 1970 150 p refs Hearings on S. 3229, S. 3466, and S. 3546 before Comm. on Public Works and Comm. on Com., 91st Congr., 2d Sess., Aug. 1970
Avail: SOD $1.00

The proposed subcommittee amendments to the Clean Air Act are presented. Opinions and suggestions are given by the air transport industry, AFL-CIO American Mining Congress, Automobile Manufacturers Association, HEW, Ford Motor Company, National Steel Corporation, Manufacturing Chemists Association, and other corporations. Comments on citizens' suits are included. P.A.B.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N70-40676# Army Natick Labs., Mass. Clothing and Personal Life Support Equipment Lab.
A STUDY OF SEAM LEAKAGE IN COATED FABRICS Summary Report, Aug. 1967 - Jul. 1969
Edward B. Frederick and Malcolm C. Henry Apr. 1970 48 p refs Series No. C/PEL-TS-169
(AD-708874; USA-NLABS-TR-70-59-CE) Avail: NTIS CSCL 11/5

Extensive investigations of sewn seams in coated fabrics have been conducted. The relative roll of thread, sewing machine components, stitch and seam types and properties of fabrics have been evaluated as parameters involved in seam leakage. Utilization of various experimental seam constructions, gasketing, application of heat during seam sewing and other techniques were attempted as potentially useful approaches in combating seam leakage. Author (TAB)

N70-40758*# Whirlpool Corp., St. Joseph, Mich. Life Support Systems Group.
DEVELOPMENT OF NON-CREAM STYLE SOUPS Final Report

Robert W. Larson 7 May 1970 13 p
(Contract NAS9-9032)
(NASA-CR-108603) Avail: NTIS CSCL 06H

The objective of this task was to develop at least two new noncream type soups for use in the Apollo feeding system. The soups were to be shelf stable for two weeks at 100 + or − 5 F when vacuum packaged in a flexible pouch. Soups submitted for evaluation are chicken noodle and vegetable, mulligatawny, oxtail, and vegetable beef. A guide for the production of the soups is included. Author

N70-40769# School of Aerospace Medicine, Brooks AFB, Tex.
DIGITAL SIMULATION AID IN DESIGNING AN AUTOMATIC EEG ANALYZER Progress Report, Oct. 1968 - Jan. 1970
Charles S. Lessard and Harry M. Hughes Jun. 1970 16 p refs
(AD-708432; SAM-TR-70-33) Avail: NTIS CSCL 6/16

Through period analysis, analog sleep EEG information was compressed into a series of numbers representing the incidence of intervals generated by zero-crossing of the EEG and its first derivative (digital differential) for 11-min. epochs. The resulting measurement vectors served not only for preliminary assessment of the descriptors as stage discriminators, but also for subjective comparison of EEG signals between leads for the same stages of sleep. In efforts to generate decision surfaces for dividing sleep into five stages (I through IV, and rapid eye movements), multivariate linear discriminant analysis was employed. To limit the number of variables for training and for discrimination of a sleep night, data from only one subject were used. A 23-variable set appeared to be the best choice. According to research results, 85% accuracy can be obtained on any night of sleep for a subject, provided that the training set is from the same subject. Author (TAB)

N70-40789# Stanford Univ., Calif. Dept. of Computer Science.
HEURISTICALLY GUIDED SEARCH AND CHROMOSOME MATCHING
Ugo Montanari Apr. 1970 31 p refs
(Contract ARPA SD-183)
(AD-709056; SU-AIM-118) Avail: NTIS CSCL 6/4

Heuristically guided search is a technique which takes systematically into account information from the problem domain for directing the search. The problem is to find the shortest path in a weighted graph from a start vertex Va to a goal vertex Vz: for every intermediate vertex, an estimate is available of the distance to Vz. If this estimate satisfies a consistency assumption, an algorithm by Hart, Nilsson and Raphael is guaranteed to find the optimum, looking at the a priori minimum number of vertices. A version of the above algorithm is presented, which is guaranteed to succeed with the minimum amount of storage. An application of this technique to the chromosome matching problem is then shown. Matching is the last stage of automatic chromosome analysis procedures, and can also solve ambiguities in the classification stage. Some peculiarities of this kind of data suggest the use of an heuristically guided search algorithm instead of the standard Edmonds algorithm. The method obtained in this way is proved to exploit the clustering of chromosome data: a linear-quadratic dependence from the number of chromosomas is obtained for perfectly cluster data. Finally, some experimental results are given. Author (TAB)

N70-40806*# Grumman Aerospace Corp., Bethpage, N.Y.
STUDY OF PERSONAL HYGIENE CONCEPTS FOR FUTURE MANNED MISSIONS Final Report
L. C. Flocke and G. J. Frankel 7 Aug. 1970 38 p
(Contract NAS9-10455)
(NASA-CR-108607; SRP-14S-004; DRD-MSC-01241) Avail: NTIS CSCL 06I

The objectives were to: (1) evaluate the applicability of existing and proposed concepts for personal hygiene systems to long-duration manned spacecraft, (2) develop concepts for personal hygiene systems applicable to long-duration manned spacecraft, (3) bring together available information into a single source manual, and (4) establish a basis for determining areas requiring future development. Requirements for personal hygiene concepts imposed by man, his vehicle, and its environment were established. Author

N70-40829# Joint Publications Research Service, Washington, D.C.
RADIATION PROTECTION TRAINING DISCUSSED
G. Sitzlack *In its* Transl. on Eastern Europe Sci. Affairs, No. 130 9 Sep. 1970 p 8-11 refs Transl. into ENGLISH from Deut. Gesundheit. (East Berlin), 6 Jul. 1970 p 1290-1292 (See N70-40826 23-34)
Avail: NTIS

The training of physicians in radiation protection is discussed. The topics include nuclear physics and safety, accident prevention, protection controls for humans, environment, and nuclear facilities, and radiation biology, genetics, and pathology. J.A.M.

N70-40845# Technische Hochschule Aachen (West Germany). Aerodynamisches Inst.
FLOW INVESTIGATIONS ON ARTIFICIAL HEART VALVES
A. Naumann and C. Kramer *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 10 p refs (See N70-40841 23-04)
Avail: NTIS

Investigations on fluid dynamics aspects in medicine were carried out and a brief summary of this work is given. Model tests on artificial aortic and mitral valves were made. The steady flow patterns have been observed in order to see the regions of critical sedimentation and vortex formation depending on the relative size and on the stroke of the valve bodies. From pressure distribution measurements around the valve bodies and along the aorta, resp. in the ventricle, the total pressure loss is given. Improvements of the valve body form are proposed. Finally the drag acting on the bodies at back flow in the closure phase could be measured. All model measurements were made in water or in air. Author

N70-40846# Technische Hochschule Aachen (West Germany). Aerodynamisches Inst.
STUDIES ON FLOW INDUCED MECHANICAL HEMOLYSIS
C. Kramer *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 18 p refs (See N70-40841 23-04)
Avail: NTIS

In blood pumping circuits, especially those including artificial heart valves, the red blood corpuscles (erythrocytes) may be damaged by mechanical factors. It is difficult to find the parameters influencing this mechanical hemolysis. Experiments under simplified flow conditions have been devised to investigate the fluid mechanical components of these problems. In a special test apparatus studies were done with fresh pig's blood. The results show that the flow induced hemolysis depends not only on the pressure loss in the flow field but also on the mechanism by which the loss is caused. Another essential parameter is the time derivative of the pressure during the flow process. Additional studies in model flows augment the discussion of the obtained results. Author

N70-40847# Politecnico di Milano (Italy). Istituto di Macchine.
FLUID-DYNAMIC CRITERIA FOR THE DESIGN AND EVALUATION OF ARTIFICIAL VALVES
C. Casci, R. Fumero, and F. M. Montevecchi *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 9 p refs (See N70-40841 23-04)
Avail: NTIS

A quantified analysis of artificial valve operation is likely to provide some bases for a deeper insight of the short and long term physiological consequences of a particular valve design. These criteria were applied to the examination of geometrical valve configurations for artificial ventricles and have produced some rather peculiar designs together with an approximated forecast of their laws of motion. Several aspects of current ball valve operation more or less interrelated with thrombous formation and hemolysis have been investigated. Quantitative analyses of time space relations determined pumping velocities at the end of the rise, rebounds, and cavitating regions on the rebounding ball back area. Analytical procedures have shown a peculiar capability for investigating the velocity patterns, pressure, and stress conditions of both the flow and ball. Author

N70-40853# Avco-Everett Research Lab., Everett, Mass.
FLUID DYNAMICS OF HEART ASSIST DEVICES
Robert T. Jones *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 96 p refs (See N70-40841 23-04)
Avail: NTIS

Reviewed are certain hemodynamic phenomena that arise in connection with the use of artificial blood pumping devices. Among these are: (1) flows produced by collapsing bulbs; (2) the impact presented by the aorta; (3) limiting velocities and instability of flow in elastic vessels; (4) effectiveness of valveless arterio-arterial pumps; and (5) wave reflection phenomena and instabilities associated with the intra-aortic balloon pump Author

N70-40872# Lille Univ. (France). Lab. de Physiologie.
MEASURE BY THERMODILUTION OF LOCAL BLOOD FLOW, PRINCIPALLY THE FLOW OF THE CORONARY SINUS [LA MESURE PAR THERMODILUTION DES DEBITS SANGUINS LOCAUX, PRINCIPALEMENT LE DEBIT DU SINUS CORONAIRE]
Yvon Houdas, Michel E. Bertrand, and Jacques Y. Ketelers *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 10 p refs In FRENCH (See N70-40841 23-04)
Avail: NTIS

A thermoelement probe for the measurement of human coronary flow is described. The technique consists of injecting into the upper part of the coronary sinus a small quantity of NaCl at 9 p. 1000 at a temperature on the order of 23 C, and studying the variation of the temperature of the blood as a function of time at the outlet of the coronary sinus. Theoretical considerations and experimental studies using a model permit the conclusion that the precision is acceptable if the moment of injection is marked with reference to the cardiac cycle. Transl. by P.A.B.

N70-40873# Centre d'Essais en Vol, Bretigny-sur-Orge (France). Lab. de Medecine Aerospatiale.
MEASURE OF BLOOD FLOW BY ELECTRIC PLETHYSMOGRAPHY: UTILIZATION IN AERONAUTICAL MEDICINE [MESURE DU DEBIT SANGUIN PAR PLETHYSMOGRAPHIE ELECTRIQUE. UTILISATION EN MEDECINE AERONAUTIQUE]
J. M. R. Demange *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 9 p refs In FRENCH (See N70-40841 23-04)
Avail: NTIS

Rheograph and electroplethysmograph apparatus, using either two or four electrodes, are discussed, and the variations of electrical impedance are examined with reference to the blood vessels. Utilization of the techniques for measuring human limb, cerebral, and cardiac blood flow is investigated. It is concluded that electroplethysmographic blood flow measurement can be useful in the study of aerospace stresses and in the course of the selection, training, and expertise of the flight staff. Transl. by P.A.B.

N70-40874# Institute of Aviation Medicine, Fliegahorst (West Germany).
TESTS ON ARTIFICIAL BLOOD FLOW BY IMPEDANCE PLETHYSMOGRAPHY
Helmut Vitz *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 4 p refs (See N70-40841 23-04)
Avail: NTIS

Measuring methods permitting reproducible measurements of the circulatory system are presented, such as determination of stroke volumes, coefficients of elasticity, changes and quantifications of peripheral circulation. The latter method is in the development phase. The high value of longtime examinations has been emphasized, since the examinations are generally conducted in subjects with a sound circulatory system. Calibration, reproducibility and validity tests of formulae were conducted with the aid of an accurately described circulatory model. Author

N70-40875# Bologna Univ. (Italy).
THE DIGITAL COMPUTER APPLIED DURING THE ARTIFICIAL HAEMODIALYSIS
S. Focardi, C. Pallotti, G. Pallotti, and F. Viaggi *In* AGARD Fluid Dyn. of Blood Circulation and Respirat. Flow Jul. 1970 8 p refs (See N70-40841 23-04)
Avail: NTIS

Possibilities to control by digital computer the artificial kidney, during application to a patient, are studied. General conditions of the patient are considered starting from Fick's law and the filtration law. The mutations of the values for toxic concentration substances in the blood are investigated when a large amount of toxic substances is produced by the human body during artificial haemodialysis. A particular program for digital computer application in clinical departments is presented. Author

N70-41000*# Grumman Aerospace Corp., Bethpage, N.Y.
STUDY OF MOBILITY AND RESTRAINT DEVICE CONCEPTS FOR FUTURE MANNED SPACE SYSTEMS Final Report, 7 Jan. - 7 Aug. 1970
C. R. Bassano and G. P. Gibbons 7 Aug. 1970 63 p refs (Contract NAS9-10456)
(NASA-CR-108609; DRD-MSC-01232; SRP-14S-104) Avail: NTIS CSCL 05E

Research is reported aimed at evaluating existing and/or proposed concepts for mobility/restraint systems, and to develop new concepts applicable to long duration manned spacecraft. The study was limited to applications for broad classes of earth orbital space stations and logistic spacecraft for the 1973 to 1978 time period. The major tasks performed were: (1) a literature search; (2) establishment of mobility and restraint requirements for long term, large spacecraft operations; (3) synthesis and development of concepts for mobility and restraint devices; (4) evaluation and selection of recommended concepts; (5) development of parametric data to establish design characteristics, spacecraft interfaces, and associated penalties; and (6) assessment of development and implementation factors. D.L.G.

N70-41006# Federal Aviation Administration, Washington, D.C.
DEVELOPING MANPOWER REQUIREMENTS IN NONSTANDARD ENVIRONMENTS WITH RANDOM WORKLOAD DEMANDS
Peter N. Kovalick [1970] 28 p refs Presented at the 21st Ann. Conf. of the Am. Inst. of Ind. Engr., Cleveland, May 1970
Avail: NTIS

The concept of developing manpower requirements in nonstandard environments with random workload demands is presented through an application in air traffic control towers. It is based on developing standard data by a microanalysis of air traffic operations. The standard data can then be used to formulate customized standards for various combinations of work situation

variables. Humanistic effects resulting from variations in workload stress and complexity are considered in relation to requirements for handling 100% of random peak traffic volumes. Both the static and dynamic characteristics and constraints of the system are treated. Author

N70-41039*# Massachusetts Inst. of Tech., Cambridge. Man–Vehicle Lab.
SENSORY FEEDBACK IN HUMAN POSTURE CONTROL
Lewis Michael Nashner (Ph.D. Thesis) Jun. 1970 209 p refs
(Grant NGL-22-009-156)
(NASA-CR-113796; MVT-70-3) Avail: NTIS CSCL 05E

Current models for physiological components and a series of experiments on human subjects form the basis for a multiloop control model which describes how a human uses multiple feedback sensors to control his orientation. Particular emphasis is placed on defining functional interfaces between the feedback sensors and postural responses. Because of the inherent complexities within the posture control system, analysis is simplified by considering only control of forward and backward rotational motions about the ankle joints during quiet standing tasks. The research effort is divided into three segments. First, a general posture control model is assembled given current models for motor and sensory components. This general model forms the basis for a series of experiments with human subjects using a specially designed two-degree-of-freedom simulator. Finally, experimental observations are combined with the general model, developing specific models which predict the observed postural responses. Author

N70-41048# American Inst. for Research, Pittsburgh, Pa.
EVALUATION OF A LOW COST IN-FLIGHT AUDIO/VIDEO RECORDING SYSTEM FOR PILOT TRAINING Final Technical Report, 15 Sep. 1967 – 28 Jul. 1968
Sanford P. Schumacher, Melvin H. Rudov, and Horace H. Valverde (AF Human Resources Lab.) Brooks AFB, Tex. Human Resources Lab. Oct. 1970 191 p refs
(Contract F33615-68-C-1048)
(AD-709213; AIR-728-7/69-FR; AFHRL-TR-69-31) Avail: NTIS CSCL 5/9

The report describes a study to determine the feasibility and effectiveness of using in flight audio/video recording and ground playback equipment in the United States Air Force undergraduate pilot training (UPT) program. It includes a detailed description of a low cost audio/video recording system (AVRS) which was developed for the study. Audio/video equipment configurations are discussed as they apply to training operations in the T-37 aircraft. A description is given of the training methodology which was formulated for integrating the audio/video recordings of student maneuvers into the flight training program. Airborne cameras were used to view the flight instruments and the pilots forward outside scene. The operational use of the AVRS is described for two ongoing classes of pilots. The results in terms of differences in achievement levels and learning rates for TV and non-TV students are described. Conclusions as to high equipment reliability and easy maintainability and the training benefits which can be expected to accrue from use of the AVRS are detailed. Author (TAB)

N70-41159*# J & J Marine Diving Co., Inc., Pasadena, Tex.
SURFACE INTERVAL PROVIDING SAFETY AGAINST DECOMPRESSION SICKNESS IN HYPERBARIC-HYPOBARIC EXPOSURES Final Report
Peter O. Edel 25 Mar. 1970 57 p refs
(Contract NAS9-9036)
(NASA-CR-108645) Avail: NTIS CSCL 05E

Astronauts are required to carry out a simulated weightlessness training program at a depth of 40 feet of fresh water. They wear space suits pressurized to 3.5 psi above ambient pressure so that they are exposed to a pressure differential equivalent to 47 feet of sea water (FSW). The underwater program varies, consisting of a single two-hour dive; or two dives lasting two hours each, with a three-hour surface interval between them; or a repetition of the two-dive schedule on a maximum of five successive days, with a minimum of 16 hours separating the work days. Following the underwater exposure, the astronauts then pilot their jet aircraft from Huntsville to Houston in a flight lasting approximately two hours. Empirical tests were carried out to determine the probability of an attack of decompression sickness during the proposed compression-decompression training schedule. As a result of the tests, surface intervals are recommended before ascent to altitude is attempted following one or more exposures to 47 FSW lasting two hours. Author

N70-41297* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LIQUID-GAS SEPARATOR FOR ZERO GRAVITY ENVIRONMENT Patent
Robert E. Smylie and Frank H. Samonski, Jr., inventors (to NASA) Issued 31 Jan. 1967 (Filed 21 Sep. 1964) 5 p Cl. 55-35
(NASA-Case-XMS-01492; US-Patent-3,300,949; US-Patent-Appl-SN-398131) Avail: US Patent Office CSCL 06K

An apparatus is described for separating the gas from the liquid-gas stream used for environmental control under zero gravity conditions. Two adjacent layers of a highly absorptive material of different density are contained in a housing. The density of the first layer is relatively loose and permits both the gas and liquid to pass through. The gas passes directly through the first layer while the liquid is absorbed and flows across the layer due to the pressure of the incoming stream. The second layer is compressed to such a density that no gas can pass through and it also absorbs the liquid upon saturation of the first layer. A check valve is provided on the gas outlet to retain a portion of the gas in the housing and to create and maintain a positive pressure on the first absorbing layer, thus forcing the liquid through the layers into a storage tank. R.B.

N70-41329* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
INSTRUMENT FOR USE IN PERFORMING A CONTROLLED VALSALVA MANEUVER Patent
Maxwell W. Lippitt, Jr. and John H. Reed, Jr., inventors (to NASA) Issued 17 Jan. 1967 (Filed 10 Dec. 1963) 7 p Cl. 128-2.05
(NASA-Case-XMS-01615; US-Patent-3,298,362; US-Patent-Appl-SN-329595) Avail: US Patent Office CSCL 06B

A device for producing a known constant positive pressure within the lungs is described. The device consists of a hollow cylinder of transparent plastic which is fitted at one end with a mouthpiece. It is provided with a piston constrained by a spring device attached to one end of the piston and an adjustment screw on the mouthpiece. When pressure is applied to the cylinder by a person exhaling through the mouthpiece, the piston moves down the bore of the cylinder against the action of the spring by a distance proportional to the pressure applied. A hole is drilled through the cylinder at a preselected distance from the mouthpiece and the subject develops a positive pressure in the lungs by exhaling with sufficient force to move the piston past the escape port. Because air continually escapes while the subject is maintaining the pressure within the cylinder, the thoracic muscles rather than the cheeks must be used to sustain the desired pressure. The device is designed for conducting the Flack test on astronauts subjected to prolonged periods of limited activity and zero gravity. R.B.

N70-41488*# Grumman Aerospace Corp., Bethpage, N.Y.
USE OF THE BEN FRANKLIN SUBMERSIBLE AS A SPACE STATION ANALOG. VOLUME 1: SUMMARY TECHNICAL REPORT Final Report

May 1970 54 p refs
(Contract NAS8-30172)
(NASA-CR-102828; OSR-70-4-Vol-1) Avail: NTIS CSCL 05E

A technical review is presented of the NASA effort using the Ben Franklin submersible as a space station analog during the 30-day drift mission in the Gulf Stream from 14 July to 14 August 1969. Psychological and physiological measurements during the pre-mission, mission, and post-mission phases were investigated as well as habitability in a closed ecosystem; microbiological analysis of the water system, human flora, and environmental samples; and maintainability considerations for scheduled and unscheduled tasks. Ben Franklin characteristics, tabulated ocean scientific data, and the Captain's log are appended. J.M.

N70-41486*# Grumman Aerospace Corp., Bethpage, N.Y.
USE OF THE BEN FRANKLIN SUBMERSIBLE AS A SPACE STATION ANALOG. VOLUME 2: PSYCHOLOGY AND PHYSIOLOGY Final Report
May 1970 122 p refs
(Contract NAS8-30172)
(NASA-CR-102823; OSR-70-5-Vol-2) Avail: NTIS CSCL 05E

A description is presented of the crew, environment, data collection, training, and pre-drift testing for the long term test of human physiological and psychological responses to long term confinement in the Ben Franklin submersible. Psychological adaptability, compatibility and interactions, and crew performance are summarized. The physical condition, medication required, food, and food preferences are included in the study of crew physiological adaptability. Living and working conditions are reported for analogy to long term space voyages. Medical and command and control comments are appended with a sample of a personal log of the submerged confinement test. J.M.

N70-41487*# Grumman Aerospace Corp., Bethpage, N.Y.
USE OF THE BEN FRANKLIN SUBMERSIBLE AS A SPACE STATION ANALOG. VOLUME 3: HABITABILITY Final Report
May 1970 121 p refs
(Contract NAS8-30172)
(NASA-CR-102830; OSR-70-6-Vol-3) Avail: NTIS CSCL 05E

Methods and limits of analysis, area utilization, crew activity and time lines, and habitability planning considerations are described for the long term habitability test on the Ben Franklin submersible. Instruments, procedures, crew pre-mission training and experience, and mission data are included in the environmental analysis. Basic food requirements, the food system, and crew acceptance are reported under food management. Hot and cold water distribution and allocation are described as well as clothing and bedding utilized during the test. Personal hygiene, noise and light levels, and free volumes and areas are also considered. Conclusions and recommendations are given for long space voyage consideration. J.M.

N70-41488*# Grumman Aerospace Corp., Bethpage, N.Y.
USE OF THE BEN FRANKLIN SUBMERSIBLE AS A SPACE STATION ANALOG. VOLUME 4: MICROBIOLOGY Final Report
May 1970 117 p refs
(Contract NAS8-30172)
(NASA-CR-102831; OSR-70-7-Vol-4) Avail: NTIS CSCL 05E

Methods are described for biological sampling and culturing from the human body, environment, water and waste water, garments and linen, and food. Total counts, simplification/shift of flora, and specific bacteria and fungi are included for each sample area, along with conclusions and recommendations. Guidelines are discussed for future space stations based on the Gulf Stream drift mission. Summaries of manned chamber tests, water chemistry, and the on-board sampling instruction manual are appended. J.M.

N70-41489*# Grumman Aerospace Corp., Bethpage, N.Y.
USE OF THE BEN FRANKLIN SUBMERSIBLE AS A SPACE STATION ANALOG. VOLUME 5: MAINTAINABILITY Final Report
May 1970 113 p refs
(Contract NAS8-30172)
(NASA-CR-102832; OSR-70-8-Vol-5) Avail: NTIS CSCL 05E

Mission planning, data acquisition and analysis, prediction techniques, pre-mission crew training, and maintainability analysis of the long term confinement test in the Ben Franklin are presented. Maintenance workload and manpower distributions are reported with an analysis of maintenance tasks. Conclusions and recommendations are given with analogy to space station maintenance. Space maintainability background, drift mission planning, maintenance procedures, and maintainability analysis and prediction techniques are appended. J.M.

N70-41581* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THREE-AXIS CONTROLLER Patent
Earl O. Menefee and Albert A. Puccinelli, inventors (to NASA) Issued 3 Jan. 1967 (Filed 27 Apr. 1964) 12 p Cl. 74-471
(NASA-Case-XAC-01404; US-Patent-3,295,386; US-Patent-Appl-SN-363348) Avail: US Patent Office CSCL 05E

The controller is operated basically by a combined hand and wrist motion and is designed for high speed aircraft or spacecraft which permit little freedom of arm movement by the operator. To provide for the complex motion of the human hand about a multiplicity of centers, the pitch control mechanism has two horizontal transverse axes arranged one behind the other. Yaw and roll are each controlled by rotating the mechanism about a single axis. It is suggested that the controller is also useful in the remote control handling of radioactive materials, control of equipment by an invalid who has the use of one hand, and remote control of steering and braking of various transportation vehicles. N.E.N.

N70-41605# Los Alamos Scientific Lab., N.Mex.
ENERGY DEPENDENCE OF ALBEDO NEUTRON DOSIMETERS PLACED ON THE HEAD
Dale E. Hankins Apr. 1970 13 p refs
(Contract W-7405-eng-36)
(LA-4341) Avail: NTIS

A study was made of the energy dependence of an albedo neutron dosimeter system placed at various locations on the head. An albedo dosimeter placed behind the ear has an energy dependence closer to the desired rem response than a chest-mounted dosimeter. The improvement in the energy response is greatest for intermediate- and low-energy neutrons, but the response for fast-energy neutrons is still poor. The large overresponse of an albedo dosimeter caused by room-scattered neutrons and shielding materials placed between the source and the dosimeter is described. The directional effect of a head-mounted albedo dosimeter was better than a chest-mounted dosimeter. NSA

N70-41661# RAND Corp., Santa Monica, Calif.
THE MIND SYSTEM. THE MORPHOLOGICAL-ANALYSIS PROGRAM
Martin Kay and Gary R. Martins Apr. 1970 92 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-709176; RM-6265/2-PR) Avail: NTIS CSCL 9/2

A detailed description of the ANALYZE module of the MIND information system is presented. This part of the system receives English sentences as input, segments them into words, and reduces the words to their ultimate lexical components through morphological analysis. Dictionary entries providing morphological, syntactic, and semantic information about the components are retrieved and amalgamated into word-level grammatical representations, and are then concatenated to form a bottom-level

grammatical representation of the input sentence. This representation is passed to the PARSE module for further processing. Significant developments incorporated in the module include: (1) a sophisticated morphological analysis procedure, (2) a very efficient dictionary referencing organization, (3) powerful techniques for representing lexical generalizations, and (4) simple but effective means for morphological recombination of lexical components. Author (TAB)

N70-41663# Michigan Univ., Ann Arbor. Dept. of Computer and Communication Sciences.
AUTOMATION DESIGN, CONSTRUCTION, COMPLEXITY AND ADAPTATION Final Report, 1 Jan. 1968 - 31 Dec. 1969
Jun. 1970 5 p refs
(Contract N00014-67-A-0181-0011)
(AD-709467) Avail: NTIS CSCL 6/4

In the two years of the contract, 15 technical reports of research in the field of theory of automata and related computer areas were submitted to the Office of Naval Research. The principal reports and publications resulting from the research are listed and a listing of the scientific personnel whose ONR supported research led to the obtaining of advanced degrees at The University of Michigan is given. TAB

N70-41684# Air Force Systems Command, Lackland AFB, Tex. Human Resources Lab.
PROFICIENCY DIFFERENCES OF PILOT AND NAVIGATOR F-4 SECOND SEAT CREWMEMBERS: A SOUTHEAST ASIA EVALUATION
C. Wayne Shore, Charles R. Curran, Forest R. Ratliff, and John R. Chiorini Brooks AFB, Tex. Apr. 1970 28 p refs
(AD-709728; AFHRL-TR-70-9) Avail: NTIS CSCL 5/9

A proficiency rating form was administered to F-4 crewmembers following each of a series of combat missions. The rating form was one of several data collection instruments developed as part of Project Combat Team to gather behavioral data designed to relate the differences in the training of pilots and navigators to operational performance. The rating categories were designed to measure proficiency in ten second-seater functions and three general characteristics related to second-seater proficiency. Using an 11-point rating scale, aircraft commanders compared their second-seat crewmember with second-seaters of equal combat experience. Differences between pilot and navigator second-seaters on each rating category were tested by a multiple linear regression analysis. Data from other instruments relevant to evaluation of mission success were also presented. Several conclusions were drawn on the basis of these data. Author (TAB)

N70-41748# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A DISCRETE STOCHASTIC OPTIMAL CONTROL MODEL OF THE HUMAN OPERATOR IN A CLOSED LOOP TRACKING TASK
Harvey M. Paskin (Ph.D. Thesis) Jun. 1970 153 p refs
(AD-709380; DS/EE/70-1) Avail: NTIS CSCL 5/8

A discrete stochastic optimal control model of the human operator is developed for the single-loop compensatory/pursuit tracking situation. The model generates signals corresponding to those in the physical closed-loop tracking situation. There is one parameter which is varied to match model-experimental normalized tracking error at one data point. With this parameter fixed, the model then predicts normalized tracking error and power spectra of control loop signals for an input which approximates a rectangular power spectrum. The model is applied to simple first and second order controlled elements in both compensatory and pursuit display situations. Author (TAB)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N70-40408 Brigham Young Univ., Provo, Utah.
HIGH PRESSURE, HIGH TEMPERATURE SYNTHESES OF SELECTED LANTHANIDE-TELLURIUM COMPOUNDS
John Francis Cannon (Ph.D. Thesis) 1969 54 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-18501

The pressure-temperature regions in which synthesis of each compound is successful were determined. Pressures to 100 kbars concurrently with temperatures to 1200 C were used in an attempt to prepare ScTe(1.7) and ScTe3, but these efforts met with failure. X-ray studies of the new compounds confirmed that they are extensions of the LTe(2-x) and LTe3 series (L = lanthanide) previously reported through dysprosium for LTe(2-x) and through thulium for LTe3. The lattice parameters are reported and compared (versus lanthanide ionic radius) with those of the previously known analogs. Dissert. Abstr.

N70-40415 National Lending Library for Science and Technology, Boston Spa (England).
A STUDY OF COMPLEX FORMATION BETWEEN BORIC ACID AND HYDROXY-ACID ANIONS IN THE ION EXCHANGER PHASE
A. L. Grekovich and E. A. Materova 28 May 1970 8 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 15, no. 1, Jan. 1970 p 187-190
(NLL-RISLEY-Trans-1919-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The reaction between boric acid and the anions of a number of hydroxy-acids (tartaric, citric, malic, and lactic acids) in the ion exchanger phase was studied as a function of the boric acid concentration in solution. Complex formation in the ion exchanger phase is discussed on the basis of the general theory of polyol-boron compound formation. It is shown that the hydroxy-acid anions are arranged in the following order: Tart(2-) > HCit(2-) > Mal(2-) > Lact(-) in their ability to form complexes with boric acid. Author

N70-40416 National Lending Library for Science and Technology, Boston Spa (England).
BOILING TEMPERATURES AND VAPOUR COMPOSITIONS IN THE SYSTEMS HF-H2O AND HF-H2SO4-H2O
E. Polyakova et al 29 May 1970 9 p refs Transl. into ENGLISH from Tr. Uralsk. Nauchn.-Issled. Khim. Inst. (Sverdlovsk), no. 1, 1954 p 68-74
(NLL-M-9178-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

An investigation of the boiling temperatures and vapor composition over boiling aq-solutions of hydrofluoric acid and its mixtures with sulfuric acid is described. The data obtained confirm the possibility of producing anhydrous hydrogen fluoride by fractional distillation of 70 to 80% HF and permit the conclusion that it is possible to produce it by fractional distillation of mixtures of 30 to 40% HF and oil of vitriol. Author

N70-40444# Yeshiva Univ., New York. Belfer Graduate School of Science.
NUCLEOPHILIC DISPLACEMENTS BY ORGANOPHOSPHORUS COMPOUNDS Final Scientific Report, 16 May 1965 - 31 Jan. 1970

Irving J. Borowitz, Howard Parnes, Steven Firstenberg, and Edward W. R. Casper 8 Jun. 1970 18 p refs
(Grant AF-AFOSR-1170-67; AF-AFOSR-1170-66; AF-AFOSR-938-65)
(AD-708517; AFOSR-70-1858TR) Avail: NTIS CSCL 7/3

The kinetics of the formation of ketophosphonium salts from the reactions of aryl-substituted alpha-bromoacetophenones and alpha-bromopropiophenones with triphenylphosphine (TPP) were determined by a conductivity method. The small rho values (+0.44, 0.67) and activation parameters obtained indicates S(N)2 pathways for these reactions. The debromination of these species with TPP-ROH were found to be general acid catalyzed. The proposed mechanisms involve attack on bromine of a general acid coordinated (on carbonyl) haloketone by TPP with varying degrees of proton transfer in the transition state. The reaction of alpha-haloketones with phosphites to give alpha-ketophosphonates, probably by S(N)2 processes, and vinyl phosphates (Perkow reaction) were studied. Hammett plots of the kinetics of formation of vinyl phosphate from aryl-substituted alpha-bromo- and alpha-chloroisobutyrophenones gave rho values of 1.89 and 2.37. Attack on bromine was not observed and the chloroketones reacted faster than the corresponding bromoketones. A mechanism involving addition of triethylphosphite (TEP) to carbonyl carbon in a slow step with subsequent rearrangement of phosphorus to oxygen and loss of halide ion is proposed. The stereochemistry of the Perkow reaction has been determined. Reactions of haloketones with phosphinites and the relative nucleophilicities of P(III) reagents are discussed. Author (TAB)

N70-40452 Purdue Univ., Lafayette, Ind.
DIFFERENTIAL CROSS SECTION MEASUREMENTS FOR NEON, METHANE AND HELIUM-ARGON SYSTEMS USING MODULATED MOLECULAR BEAMS
Walter Harrison Williams (Ph.D. Thesis) 1969 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-17293

Absolute differential scattering cross sections were obtained for neon, methane, and helium-argon systems using a crossed molecular beam technique. The primary beam is chopped mechanically by a tuning fork whose standard source serves as a reference for a lock-in amplifier, oscilloscope, and signal averaging Enhancetron. The resultant intensity was measured with an EAI quadrupole residual gas analyzer. The signal from the QRGA was amplified by narrow bandpass filters, and then by a lock-in amplifier or Enhancetron. The Enhancetron technique is superior to lock-in amplification. There are discrepancies between the data and Lennard-Jones potential predictions. These discrepancies, however do not seem to lessen the data's sensitivity to the form of the intermolecular potential and seem to be outside the range of any large systematic error. Dissert. Abstr.

N70-40476 Michigan Univ., Ann Arbor.
THE THIN FILM GOLD ELECTRODE: A NEW TOOL FOR SIMULTANEOUS ELECTROCHEMICAL AND INTERNAL REFLECTION SPECTROMETRIC MEASUREMENTS
Arnold S. Prostak (Ph.D. Thesis) 1969 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-18086

A discussion is given of the optical considerations important in obtaining internal reflection spectra through a gold film and it is concluded that parallel polarized light should be used, the gold film thickness should be less than 8 nm (80 A), and the presence of the gold film does not appreciably distort the spectrum in the near ultraviolet, visible, and near infrared region. Measurements were made as a function of angle of incidence, plane of polarization, optical frequency, and potential-scan frequency. The change in reflectance was as much as 7% at 480 nm wavelength for one reflection using perpendicular polarized light just beyond the critical angle. This change in reflectance was identified with the smaller external reflectance change reported by Feinleib in 1966 and it is found to be due to a modulation of the optical properties of the gold and not to changes in the electrolyte. The change in the gold optical properties was found to be related to a change in the free-electron concentration in the gold. Dissert. Abstr.

N70-40479 Michigan Univ., Ann Arbor.
FRACTIONATION OF OXYGEN-NITROGEN GAS MIXTURES BY NON-EQUILIBRIUM FACILITATED DIFFUSION IN LIQUID MEMBRANES
Robert James Bassett (Ph.D. Thesis) 1969 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-17963

Diffusion in the cobaltodihistidine-oxygen system was, under the imposed experimental conditions, best represented by the restraints of non-equilibrium mathematical model. The chemical reaction rates realized were not sufficiently rapid to allow modeling by an equilibrium system in which the species concentrations at each point along the diffusion path obey the chemical equilibrium relation. This is the primary feature that distinguishes this system from the hemoglobin-oxygen system for which the equilibrium assumption is valid everywhere within the liquid film. Dissert. Abstr.

N70-40495 National Lending Library for Science and Technology, Boston Spa (England).
RADIO-GAS CHROMATOGRAPHIC ANALYSIS OF METHYL ESTERS OF FATTY ACIDS AND STEROIDS [RADIO-GAS-CHROMATOGRAPHISCHE ANALYSE VON FETTSAEUREMETHYLESTERN UND STEROIDEN]
B. Kolb et al 8 Jun. 1970 15 p refs Transl. into ENGLISH from Z. Anal. Chem. (Berlin), no. 243, 1968 p 129-142
(NLL-LB/9/2864-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Comparative studies are described of radio-gas chromatography, using a proportional flow counter, of C-14 and H-3 labeled compounds, previously separated by gas chromatography, after decomposition by either hydrogenation or oxidation. Counting efficiencies of 100% were found for both C-14 and H-3 labeled compounds when hydrogenation was used. The determination of specific activities in C-14 labeled methyl esters of fatty acids showed good agreement between the results from hydrogenation and oxidation. Examples are quoted for the analysis of H-3 labeled steroids after hydrogenation and of C-14 labeled steroids after oxidation. The possibility of employing thin layer capillaries in radio-gas chromatography is also reported. Author

N70-40529 National Lending Library for Science and Technology, Boston Spa (England).
COMPARISON OF DIFFERENT METHODS FOR THE DETERMINATION OF THE CAPACITY OF ANION EXCHANGE RESINS
H. Berg 22 Jun. 1970 12 p refs Transl. into ENGLISH from Mitt. Ver. Grosskesselbesitzer (Duesseldorf), v. 48, Dec. 1968 p 458-463
(NLL-CE-Trans-5322-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Three methods are compared which can be used to determine the total capacity and partial capacities (towards anions of strong or weak acids) of anion exchange resins. The absolute values obtained by these methods differ from each other but the differences are relatively constant. The reliability and the applicability of the three methods are examined. Author

N70-40538# National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
HYDROGEN STARK BROADENING CALCULATIONS WITH THE UNIFIED CLASSICAL PATH THEORY

C. R. Vidal, J. Cooper, and E. W. Smith May 1970 147 p refs
(Contract DA-31-124-ARO(D)-139)
(AD-708622; NBS-MONOGRAPH-116) Avail: SOD $1.50; NTIS CSCL 7/4

The unified theory has been generalized for the case of upper and lower state interaction by introducing a more compact tetradic notation. The general result is then applied to the Stark broadening of hydrogen. The thermal average of the time development operator for upper and lower state interaction is presented. Except for the time ordering it contains the effect of finite interaction time between the radiator and perturbers to all orders, thus avoiding a Lewis type cutoff. A simple technique for evaluating the Fourier transform of the thermal average has been developed. The final calculations based on the unified theory and on the one-electron theory are compared with measurements in the high and low electron density regime. The unified theory calculations cover the entire line profile from the line center to the static wing and the simpler one-electron theory calculations provide the line intensities only in the line wings. Author (TAB)

N70-40572# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE THERMAL GROWTH OF THE FORMYL RADICAL AT 87 K IN A 50% METHANOL-WATER MATRIX
Cornelius U. Morgan May 1970 21 p refs
(AD-708543; BRL-1481) Avail: NTIS CSCL 7/5

Formyl radicals were produced by ultraviolet irradiation of a 50% methanol-water matrix at 77K and the electron spin resonance (ESR) signal was monitored first at 77K and then at 87K. No signal change was observed as a function of monitoring time at 77K but at 87K the signal amplitude increased. The following are proposed as possible explanations. Hydrogen atoms escape from traps and diffuse through the matrix and (1) react with carbon monoxide molecules at 87K to form formyl radicals or (2) abstract a hydrogen atom from formaldehyde to form formyl radicals and molecular hydrogen. Author (TAB)

N70-40574 Columbia Univ., New York.
THE EFFECT OF SURFACE CONDUCTION ON STREAMING POTENTIAL MEASUREMENTS: ELECTROKINETIC CONTROL OF PROCESSES USING CATIONIC POLYMERS AS FLOCCULANTS
Richard Ross Fyfe (Ph.D. Thesis) 1969 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-17586

Studies were made of flocculation of dilute-electrolyte aqueous silica suspensions using a cationic poly-electrolytic polymer (i.e., a polyethyleneimine) as the flocculant. For a series of systems indexed by various initial flocculant concentrations, both refiltration rates and streaming potential measurements were made. This series was repeated at three levels of KCl concentration, 0.0001 N, 0.001 N and 0.01 N, thereby covering the use of streaming potential data for control over a large range of possible potable water systems. Results show that, by measuring the floc bed depth and total electrical resistance of the streaming potential cell, as well as the streaming potential and its corresponding pressure difference driving force, a control factor, valid over the potable water range, can be calculated for each flocculation system investigated. Analysis of data gives evidence that the effect of surface conduction is reduced by increasing amounts of added flocculants. Dissert. Abstr.

N70-40582 Maryland Univ., College Park.
THE EFFECT OF SMALL SURFACE WAVES ON MASS TRANSFER
George Franklin Dick, Jr. (Ph.D. Thesis) 1969 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-16606

A mass transfer study of mechanically generated small surface waves at nominal frequencies of 400, 600 and 800 cpm across the gas-liquid interface was undertaken. Surface renewal models based on wave induced currents were proposed to explain existing gas absorption data. Evaporation through n-hexadecanol was investigated with emphasis on the role of surface waves in changing the evaporation retarding properties of the film. The surfactant effect on amplitude and wave length damping at three frequencies was measured. A surface renewal model was found to represent the absorption of carbon dioxide, oxygen, propylene, and helium into water. The velocities were found to have the same frequency dependence as the experimentally determined velocities. Mass transfer coefficients were also calculated, and a dimensionless correlation was obtained between Sherwood and Reynolds numbers. Dissert. Abstr.

N70-40585# Kentucky Univ., Lexington. Dept. of Chemistry.
CONDUCTANCES, VISCOSITIES, AND RELATED PROPERTIES OF CONCENTRATED SOLUTIONS OF Bu4NI, KSCN, AND NH4Br IN N, N-DIMETHYLFORMAMIDE FROM −50 TO +125 C
Teofila V. Rebagay and Paul G. Sears Jun. 1970 25 p refs
(Contract DAAB07-69-C-0366; Proj. Themis)
(AD-708884; THEMIS-UK-RR-14) Avail: NTIS CSCL 7/4

Conductance, viscosity, and density data at 25C-intervals between -50 and 125C are reported for moderately concentrated solutions of Bu4NI, KSCN, and NH4Br in N,N-dimethylformamide. Results are summarized for the fitting of these data as functions of temperature and molar concentration to appropriate polynomial equations by digital computer methods. Conductance maxima, conductance-viscosity products, and activation energies of conductance and viscous flow also are discussed. Author (TAB)

N70-40586 California Univ., Berkeley.
MICROWAVE SPECTRUM AND RING PUCKERING POTENTIAL OF 1,1-DIFLUOROCYCLOPENTANE. [with] PART 2: COMPUTERS AS INTERACTIVE DEVICES IN CHEMICAL EXPERIMENTS
Richard Gordon Clark Millikan (Ph.D. Thesis) 1969 72 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-18952

The microwave spectrum of 1,1 difluorocyclopentane was studied in detail. The rotational spectra for the lowest ten vibrational states were assigned. Microwave-microwave double resonance techniques were used extensively in the assignment of two of these states. An analysis of the vibration-rotation interaction present in the spectra yielded a determination of the potential energy surface governing the out-of-plane motions of the ring-skeletal atoms. The molecule was found to be stably bent with a barrier to pseudo-rotation of 280 + or − 20/cm. An interpretation of the potential in terms of a molecular model for the out-of-plane vibrations was made. An interface between a Varian A-60 NMR spectrometer and a small digital computer is described. A number of general aspects of the use of computers as interactive elements in chemical experiments are discussed. Dissert. Abstr.

N70-40606 Princeton Univ., N.J.
MANIFESTATIONS OF VISCOELASTICITY IN LINEAR AMORPHOUS SYSTEMS
L. Lawrence Chapoy (Ph.D. Thesis) 1969 176 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-18155

The design and calibration of a ball indentation stress relaxation penetrometer are discussed. This new device is useful for the measurement of the viscoelastic properties of materials in which viscous effects dominate the mechanical response. Viscoelastic experiments on amorphous solids were designed to evaluate the applicability of segmental polymer theories in predicting mechanical response. A case is made for considering the torsional oscillator

motions of phenyl groups in polystyrene to be a manifestation of a three-dimensional damped Debye lattice. An experimental study of an organic glass was undertaken to compare its relaxation spectrum with theoretical and other convenient relaxation spectra. The effect of diluents on the viscoelastic properties of polystyrene is studied. It is shown how linear viscoelastic theory can be the focal point for understanding macroscopic behavior of polymer systems. The two phenomena considered are the strong dependence of viscosity on shear rate for polymeric systems and the Barus effect. Dissert. Abstr.

N70-40610# Tufts Univ., Medford, Mass. Dept. of Chemistry.
THE SOLUTION CHEMISTRY OF POLYHEDRAL BORON HYDRIDE IONS Final Scientific Report
Alexander Kaczmarczyk Jun. 1970 14 p refs
(Grants AF-AFOSR-1665-69; AF-AFOSR-589-64)
(AD-708525; AFOSR-70-1842TR) Avail: NTIS CSCL 7/2

The investigation was concerned with the properties of polyhedral boranes. The enthalpy, entropy and free energy of formation of B10H10(2-) were determined. The diamagnetic susceptibilities and polarizabilities of a series of polyhedral boranes and corresponding halides were measured. New syntheses of B20H19(3-) and of chlorinated and brominated B10-compounds with fewer than seven halogens were developed. Reactions of B10H10(2-) with: CuCl2, CuBr2, CuF2, FeCl3, Fe(NO3)3, KMNO4, K2Cr2O7, KIO3, KCLO3, KBrO3, and Hs4XeO6, were explored and the products characterized. The studies were done in aqueous and non-aqueous media. Free radical intermediates in the oxidation reactions were identified. Author (TAB)

N70-40662# Tyco Labs., Inc., Waltham, Mass. Corporate Research Div.
THE EFFECT OF ADSORBED LAYERS ON THE ANODIC OXIDATION OF SIMPLE ORGANIC COMPOUNDS. 3: Cu ABSORPTION ON Pt AND ITS EFFECT ON OXIDATION OF HCOOH Interim Technical Report
A. H. Taylor, S. Kirkland, and S. B. Brummer Jul. 1970 23 p refs Submitted for publication
(Contract N00014-66-C-0210)
(AD-708413; TLI-317; ITR-7) Avail: NTIS CSCL 7/4

The adsorption and desorption of Cu on a smooth Pt electrode from 1M H2SO4 solutions which contain a range of Cu(2+) concentrations has been studied as a function of potential. The effect of adsorbed Cu on the oxidation rate of HCOOH has been examined at +0.60 V (RHE). Cu(2+) adsorption is controlled largely by an activation process. The slow step in this process is apparently the discharge of Cu(2+) at the electrode to Cu(+). Analysis of the oxidation state of the adsorbing layer by charge and coverage measurements yields a value of 1.92 electrons/site. This indicates that the major part of the layer is Cu(ads) attached to a single Pt surface site. The rate of adsorption of Cu(2+) is decreased slightly in the presence of 0.1 M HCOOH. At low coverages a slight enhancement of the HCOOH oxidation rate is observed at +0.60 V. Results are interpreted in terms of Cu(2+) adsorption mechanisms on Pt and the effect of the adsorbed layer on the mechanisms of HCOOH electrooxidation on Pt. Author (TAB)

N70-40672# Tyco Labs., Inc., Waltham, Mass. Corporate Research Div.
THE EFFECT OF ADSORBED LAYERS ON THE ANODIC OXIDATION OF SIMPLE ORGANIC COMPOUNDS. 2: ROLE OF ABSORBED HCOOH SPECIES Interim Technical Report
A. H. Taylor, R. D. Pearce, and S. B. Brummer Jul. 1970 19 p refs Submitted for publication
(Contract N00014-66-C-0210)
(AD-708412; ITR-6) Avail: NTIS CSCL 7/4

The anodic oxidation of 0.1M HCOOH on smooth Pt electrodes in 1M H2SO4 at 40C has been examined. An adsorbed material with a high coverage accumulates on the electrode over a wide potential range. The rate of adsorption of this material is not limited by mass transport. A maximum coverage is indicated at +0.30 V, and this falls to zero by 0.65 V (RHE). This material poisons the main HCOOH yields CO2 reaction at all potentials. The main oxidation process at < or = 0.45 V (RHE) proceeds via an adsorbed intermediate which has not been isolated on the surface. Electron transfer is the rate-limiting step. A possible electroactive solution species is suggested. Author (TAB)

N70-40681# Georgetown Univ., Washington, D.C. Dept. of Chemistry.
HETEROPOLY COMPOUNDS OF VB ELEMENTS Final Report, 1 Mar. 1966 - 31 May 1970
Michael T. Pope 31 May 1970 15 p refs
(Grant AF-AFOSR-1066-66)
(AD-708503; AFOSR-70-1867TR) Avail: NTIS CSCL 7/2

The report reviews the chemistry of isopoly anions of vanadium, niobium and tantalum, and describes the preparation and properties of fifteen heteropolyanions of these elements. No discrete heteropoly niobates and tantalates have previously been reported. Several new complexes of manganese and nickel in the rare +4 oxidation state are described. Mixed-valence heteropoly anions containing vanadium are reported for the first time. Optical and esr spectroscopy of these species are used to determine their electronic structures. Comparisons are made between heteropolyanions of Group V and Group VI elements, and transition metal oxides. Author (TAB)

N70-40682# California State Coll., Los Angeles. Dept. of Chemistry.
THE PREPARATION OF THE PENTAGONAL PYRAMIDAL CARBORANE, 2,3,4,5-C4B2H6
Thomas Onak and George T. F. Wong Jun. 1970 8 p refs Submitted for publication
(Contract Nonr-3364(00))
(AD-708414; TR-28) Avail: NTIS CSCL 7/2

The pentagonal pyramidal carborane, 2,3,4,5,-C4B2H6, was prepared from 1,2-tetramethylenediborane(6). The conversion was accomplished at 550C using a high-vacuum system which permits a rapid flow of reactant through the hot zone at low pressures. The evidence used to establish the formula and structure of 2,3,4,5,-tetracarba-nido-hexaborane(6) include (a) a mass spectrum cutoff at m/e = 78, (b) two doublets of equal area in the 11B nmr, (c) two singlets and two quartets in the 1H nmr which can be assigned to the two C-H and two kinds of B-H groups, respectively, and (d) the presence of C-H and B-H stretching frequencies in the infrared and the absence of B-H-B bridge frequencies. Author (TAB)

N70-40740# Northeastern Univ., Boston, Mass. Dept. of Chemistry.
MEASUREMENT OF HEATS OF ADSORPTION OF INSOLUBLE VAPORS ON WATER SURFACES BY GAS CHROMATOGRAPHY
Barry L. Karger, Peter A. Sewell, Reynaldo C. Castells, and Arleigh Hartkopf 1 Jul. 1970 35 p refs Presented at the 44th Natl. Colloid Symp., Bethlehem, Pa., Jun. 1970
(Contract N00014-68-A-0207-0002)
(AD-708439; TR-1) Avail: NTIS CSCL 7/4

The use of gas chromatography for the study of the adsorption of insoluble vapors on water surfaces is described. The method involves using water coated on a porous support as packing material and presaturation of the carrier gas with water to prevent bleeding from the column. For saturated hydrocarbons it is found that the mechanism of retention is adsorption at the gas-liquid interface, while for aromatic hydrocarbons a mixed mechanism of adsorption

and solution occurs. Contrary to recent literature results, the differential heats of adsorption for the insoluble vapors are found to be 1 to 1.5 kcal/mole smaller than the heats of liquefaction. Possible causes for the discrepancy are examined in detail. The question of bulk water in the pores is explored via the partition coefficients of aromatic hydrocarbons. Author (TAB)

N70-40768# Illinois Univ., Urbana. Noyes Chemical Lab.
DENSITY DEPENDENCE OF Xe 129 CHEMICAL SHIFTS IN MIXTURES OF XENON AND OTHER GASES
C. J. Jameson (Loyola Univ., Chicago, Ill.), H. S. Gutowsky, and A. K. Jameson 25 Jun. 1970 51 p refs Submitted for publication Sponsored in part by ONR and NSF Prepared in cooperation with Loyola Univ., Chicago
(Contract N00014-66-C-0010)
(AD-708410; TR-21) Avail: NTIS CSCL 7/4

Unlike other chemical shifts in gaseous systems which have been found to have strictly linear dependence on density, it was found that the 129Xe chemical shift in pure xenon gas to have a quadratic and cubic dependence in addition to the dominant linear dependence on density. This implies the importance of three or more body interactions in xenon. In mixtures of xenon with another gas (Ar, Kr, CO2, HCl, CH4, CH3F., CH2F2, CHF3, CF4), the dependence of the 129Xe chemical shift on the density of the other gas was found to be linear within experimental error, and varying from 2300 to 11,700 ppm/mole/cc. These shifts are orders of magnitude greater than the reported H and F shifts in gases. Author (TAB)

N70-40895*# Whittaker Corp., San Diego, Calif. Research and Development Div.
STUDY OF HIGHLY FLUORINATED HETEROCYCLIC POLYMERS FOR CRYOGENIC BLADDER APPLICATIONS Final Report, 15 Oct. 1968 - 15 Mar. 1970
Beatrix Y. Sanders and Walter P. Fitzgerald, Jr. Mar. 1970 64 p refs Prepared for JPL
(Contract NASw-1822)
(NASA-CR-113810) Avail: NTIS CSCL 07C

Investigations for a polymer system displaying cryogenic flexibility for bladder applications included a large family of new highly fluorinated heterocyclic elastomers. These elastomers were prepared by a variety of chain-extension and extension-crosslinking reactions on functionally-terminated prepolymers based on poly(perfluoropropylene oxide). Although none of the elastomers was flexible in liquid nitrogen, it was possible to correlate degree of chain-extension and crosslink density with polymer glass transition temperature. In this manner it was possible to prepare highly-extended elastomer system with T(sub g) values approaching -100 C. Among the most satisfactory elastomer systems were those prepared with the triazine heterocycle, extended through amino groups (of melamine, or melamine-terminated prepolymer) to cyanurate-urea extensions, as well as through hydrazine linkages (of cyanuric trihydrazine) to cyanurate-semicarbazide extensions. It was found that, for flammability purposes, aromatic ring hydrogens cannot be tolerated, as was found with a flammable trimesoyl hydrazine-extended elastomer system. Author

N70-40910# Bureau of Mines, Albany, Oreg. Thermodynamics Lab.
THERMODYNAMIC DATA FOR SILVER CHLORIDE AND SILVER BROMIDE
L. B. Pankratz Sep. 1970 15 p refs
(BMRI-7430) Avail: Issuing Activity

Enthalpies above 298 K were determined for AgCl to 1,400 K and for AgBr to 1,200 K by copper-block calorimetry. Before melting, both compounds showed an anomalous increase in enthalpy, an effect associated with lattice defect formation. Melting points and heats of fusion were determined to be AgCl, 730 K and 2,945 cal/mole; AgBr, 700 K and 2,030 cal/mole. The heat capacity of both melted substances decreased with increasing temperature over the entire liquid ranges investigated. Enthalpies above 298 K were tabulated at even temperatures along with derived entropy increments and heat capacity values. The results were combined with the known heats of formation and entropies at 298.15 K to obtain values of the heats and free energies of formation over the range 298.15 to 1,400 K for AgCl and 298.15 to 1,200 K for AgBr. Author

N70-40916 National Lending Library for Science and Technology, Boston Spa (England).
THIN LAYER CHROMATOGRAPHY: METHODS, INFLUENCING FACTORS AND SOME EXAMPLES OF ITS USE
E. Stahl 22 Jun. 1970 12 p refs Transl. into ENGLISH from Pharmazie (Berlin), v. 11, 1951 p 633-637
(NLL-CE-Trans-5394-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A simple method for applying very thin layers of silica onto glass sheets is described. Very small quantities of mixtures of naturally occurring materials (for example, essential oils or alkaloids) can be separated on these layers by using appropriate solvents. The time required to run the separation is short. Aggressive reagents can be used for visualisation of the separated substances without damaging the layer. The factors which affect the resolution and the R sub f value were investigated and examples of the use of the method together with some of the results are reported. Author

N70-40937 National Lending Library for Science and Technology, Boston Spa (England).
ISOTOPIC ANALYSIS OF N15-LABELLED NITRATES
F. Lantelme et al 8 Jun. 1970 6 p refs Transl. into ENGLISH from Bull. Soc. Chim. France (Paris), v. 4, 1968 p 1314-1315
(NLL-LB/G/2799-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The N-14/N-15 isotopic ratio in inorganic nitrates was measured by mass spectrometer analysis of the nitric oxide NO obtained by reducing the nitrates in a sulphuric acid medium. The process is easy to carry out and avoids the risk of contamination by atmospheric nitrogen. The minimum quantity of nitrates required for one measurement is of the order of 0.1 micromole, so that the N-14/N-15 ratio is determined with an accuracy of 0.5%. The operating conditions are described in detail. Author

N70-40977# Georgetown Univ., Washington, D.C. Dept. of Chemistry.
ON THE COUPLING OF INTERFACIAL AND DIFFUSIONAL IMPEDANCES, 2
Hector Moreira and Robert De Levie 15 Jul. 1970 41 p refs Submitted for publication
(Contract N00014-69-A-0220-002)
(AD-709157; TR-3) Avail: NTIS CSCL 7/4

Previously the authors illustrated the existence of a coupling between interfacial and diffusional impedances. They considered both redox and desad (reduction -oxidation and desorption-adsorption) processes at the electrode interface, while diffusion was assumed to be planar in both cases. The ensuing relations showed that the diffusional (Warburg) impedance is a function of the interfacial impedance, even to the extent that the sign of the diffusional impedance is determined by that of the interfacial impedance. In the present paper, the above results will be extended to include first-order chemical reactions in the homogeneous solution, as well as the important class of so-called passivating electrode reactions. Explicit solutions will be given for four relatively simple cases. The method used can readily be extended to more complicated reaction schemes, at a corresponding loss of simplicity of the resulting equations. Author (TAB)

N70-40987# Technische Univ., Berlin (West Germany).
KINETIC ANALYSIS OF COPOLYMERIZATION OF OLEFIN COMPOUNDS AND MOLECULAR OXYGEN [KINETISCHE UNTERSUCHUNGEN ZUR COPOLYMERISATION VON OLEFINISCHEN VERBINDUNGEN UND MOLEKULAREM SAUERSTOFF]
Volker Serini (Ph.D. Thesis) 1968 124 p refs In GERMAN
Avail: NTIS

The reaction rate constants of the growth and breakdown for radical copolymerization of olefin monomers with oxygen were investigated. The effects of solvents on the constants were also studied. The monomers considered were styrol, alpha-methylstyrol, and methyl methacrylate, with AIBN used as an initiator. The average life of the radical chains were determined for the olefin compounds by the rotating sector method. Transl. by R.B.

N70-41041# Washington State Univ., Pullman. Dept. of Physics.
EQUATIONS OF STATE IN LIQUIDS Technical Summary Report, 8 Nov. 1967 - 7 Jan. 1969
C. T. Tung, Dan McLachlan, Jr., and G. E. Duvall Apr. 1970 132 p refs
(Contract DA-04-200-AMC-1702(X))
(AD-708772; WSU-SDL-69-01; BRL-CR-10; TSR-3) Avail: NTIS CSCL 7/4

Part I of the report is an extension of Eyrings Significant Structure Theory of the liquid state to high pressures. This extension is accomplished by introducing a Lennard-Jones and Devonshire cell model for calculating the energy of cold compression used in the solid part of the partition function. This potential is used to determine the frequency of oscillation in an Einstein solid or to determine the total classical partition function. Part II examines the basic physical concepts of the liquid state and proposes an alternative to the Eyring hole theory based on the mobility of atoms trapped between two partially separated layers. Some predictions based on this model are compared with experimental data. Author (TAB)

N70-41070# Tyco Labs., Inc., Waltham, Mass. Corporate Research Div.
THE EFFECT OF ADSORBED LAYERS ON THE ANODIC OXIDATION OF SIMPLE ORGANIC COMPOUNDS. 5: Ag ADSORPTION ON Pt AND ITS EFFECT ON HCOOH OXIDATION Interim Technical Report
A. H. Taylor, S. Kirkland, and S. B. Brummer Jul. 1970 19 p refs Submitted for publication
(Contract N00014-66-C-0210)
(AD-709121; TLI-320; ITR-8) Avail: NTIS CSCL 7/4

The adsorption of Ag on a smooth Pt electrode in 1M H2SO4 at 40C has been studied from 0.45 to 0.75 V versus RHE in solutions varying from 10 to the -4th to -6th M. The effect of adsorbed Ag on the oxidation rate of HCOOH has been examined at 0.65 and 0.75 V. A diffusion limited adsorption process is indicated. Analysis of the oxidation state of the adsorbed layer suggests, in the one case, a mixed layer composed of Ag singly bonded to a single Pt site with some single bonding to two Pt sites. At the higher coverages, two Ag atoms are apprently attached to a single Pt surface site. The rate of adsorption of Ag(+) is decreased by the presence of HCOOH. Author (TAB)

N70-41101# Technische Univ., Berlin (West Germany).
RADIOGRAPHIC RESEARCH OF HIGHLY DISPERSED SILICIC ACID [ROENTGENOGRAPHISCHE UNTERSUCHUNGEN AN HOCHDISPERSEN]
Karl Schueller (Ph.D. Thesis) 1968 82 p refs In GERMAN
Avail: NTIS

The radiographic analysis of highly dispersed silicic acids is described. The chemical properties, molecular structure, test equipment, and procedures are discussed. Transl. by P.N.F.

N70-41204*# Colorado State Univ., Fort Collins. Dept. of Chemistry.
ELECTROCHEMICAL STUDIES IN ALUMINUM CHLORIDE MELTS Semiannual Status Report, 15 Feb. - 14 Aug. 1970
R. A. Osteryoung 14 Aug. 1970 80 p refs
(Grant NGR-06-002-088)
(NASA-CR-113887) Avail: NTIS CSCL 07D

A relatively simple electrolytic procedure has been developed which appears to give very pure NaAlCl4 melts. Coulometric generation of silver ions has been used to introduce known amounts of silver ion into the melts. By potentiometric measurements, Nernst behavior was shown and a standard potential for the silver-silver ion couple determined. Some preliminary cyclic voltammetry and pulse polarographic measurements were carried out on the Ag-ion/Ag and Pb-ion/Pb electrode systems. The results indicate that the Ag-ion system is a reversible one electron process. Results with Pb-ion are fragmentary, but indicate that Pb(II) has a limited solubility in the melt. Programs have been developed and debugged which allow pulse polarography with variants and staircase voltammetry with variants to be performed under the control of a Digital Equipment Corporation PDP-8/I computer. Ensemble averaging and digital, least squares smoothing are options within these programs. One program also is capable of automatic peak height and position determination. Author

N70-41208# National Bureau of Standards, Washington, D.C. Analytical Chemistry Div.
PRESENT STATE OF THE CLASSICAL THEORY OF QUANTITATIVE ELECTRON MICROANALYSIS
Kurt F. J. Heinrich Aug. 1970 19 p refs Submitted for publication
(NBS-TN-521) Avail: SOD $0.30

A brief account of recommended expressions and procedures is given. Reference is made to the standard reference materials of Au-Ag and Au-Cu alloys issued for electron probe microanalysis. These are especially useful for investigating the application of correction procedures. Author

N70-41210# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
CONDENSATION BY HOMOGENEOUS NUCLEATION IN THE VAPOR PHASE
Peter P. Wegener and Jean-Yves Parlange Jun. 1970 40 p refs
(Contract Nonr-609(47))
(AD-709371; Rept-14) Avail: NTIS CSCL 7/4

The history of nucleation theory and experimentation since 1926 is recounted and the current status of the theory is reviewed. The review reveals points that apparently went unnoticed in the past. A comparison of data obtained by cloud chambers and nozzles with theory points to essential agreement with the so-called classical theory. New results on the condensation of ethanol are added. Author (TAB)

N70-41211# Aerospace Corp., El Segundo, Calif. Lab. Operations.
OSCILLATOR STRENGTHS OF THE HOPFIELD ABSORPTION SERIES OF N SUB 2, JUNE 1969 - JUNE 1970
Gilbert R. Cook 30 Jul. 1970 12 p refs
(Contract F04701-69-C-0066)
(AD-709206; TR-0059(9260-01)-5; SAMSO-TR-70-260) Avail: NTIS CSCL 7/4

The oscillator strengths of the Hopfield absorption series of N2 were determined from data obtained with a 1-meter radius, vacuum ultraviolet scanning monochromator. For series members in the 671.4 to 723.2 A region, the absorption f-value decreased from 0.013 to 0.0008 for m = 3 to m = 7. Author (TAB)

N70-41212# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
COMPUTER EVALUATION OF MAYER IRREDUCIBLE INTEGRALS IN ONE DIMENSIONAL SYSTEMS
Alan J. Liebman and Jean-Yves Parlange Mar. 1970 33 p refs
(Contract Nonr-609(47))
(AD-709372; Rept-15) Avail: NTIS CSCL 7/4

Irreducible integrals for general one-dimensional interaction potentials are evaluated as functions of sets of n-neighbor Mayer f-functions. Exact general evaluations are tabulated for first and second neighbor forces and for k = or < 5. These results are particularized to the nearest-neighbor (Ising) gas, the hard rods gas and the Curie-Weiss gas. Uses of these exact results in analytical studies are discussed. Author (TAB)

N70-41233# White Sands Missile Range, N.Mex. Atmospheric Sciences Lab.
A NEW METHOD FOR DETECTING MICRON-SIZED SULFATE AND WATER-SOLUBLE PARTICLES AND ITS USAGE Research and Development Technical Report
Gayle S. Rinehart May 1970 32 p refs
(AD-709609; ECOM-5302) Avail: NTIS CSCL 7/4

An easily prepared, chemically sensitive substrate for the detection of soluble micron-sized atmospheric sulfate and certain other water-soluble particles, with a light microscope, was developed. The substrate is made from an aqueous solution of polyvinyl alcohol (PVA), barium chloride, glycerol, and Triton X-100 which is spread on a glass slide and dried. Particles are collected on the slide and then observed under a dark field or phase contrast optical microscope. Under humid conditions, barium chloride reacts with sulfate particles to form PVA-insoluble barium sulfate. This precipitates in a Liesegang ring, while nonsulfate water-soluble components dissolve into the PVA medium. Photomicrography before and after moisture treatment reveals the sulfate and soluble constituents of the particulate sample. The method can be employed to detect sulfate particles as small as 0.3 microns. The number of soluble particles and percent sulfate composition per particle in aerosol samples can be estimated. Comparison of sampled atmospheric aerosol sulfate weight to sulfate weights of similarly unpolluted locations supports the validity of the method. Author (TAB)

N70-41234# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
THE APPLICATION OF MAYER'S THEORY TO THE CURIE-WEISS GAS MODEL
Alan J. Liebman and Jean-Yves Parlange Apr. 1970 19 p refs
(Contract Nonr-609(47))
(AD-709374; Rept-17) Avail: NTIS CSCL 7/4

The analysis of a Curie-Weiss gas using Mayers theory of real gases is re-examined. One-phase irreducible integrals are calculated and these provide a new proof of a theorem on star graphs. For low temperatures, the coefficients of the Mayer virial and fugacity expansions are derived. Both of these series exhibit condensation. Author (TAB)

N70-41240*# National Bureau of Standards, Washington, D.C.
THERMODYNAMIC PROPERTIES OF COMPOUNDS OF BIOCHEMICAL INTEREST IN AQUEOUS SOLUTION. A SURVEY OF THERMODYNAMIC PROPERTIES OF THE COMPOUNDS OF THE ELEMENTS CHNOPS Progress Report
R. C. Wilhoit, Jing Chao, and Michael Carlo 4 Aug. 1970 89 p refs
(NASA Order W-12758)
(NASA-CR-113949; NBS-10291; PR-18) Avail: NTIS CSCL 07C

Research is reported on a long range project for the selection and tabulation of the thermodynamic properties of organic compounds of biological importance. A method of representing the properties of binary systems, which insures thermodynamic consistency, is described and applied to the systems consisting of methanol, ethanol, n-propanol, iso-propanol, and n-butanol with water. Tables of a selected list of thermodynamic properties are presented at temperatures of 10, 25, and 40 C. An extensive bibliography and compound index to the thermodynamic properties of organic compounds in aqueous solution is also included. Author

N70-41245# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
APPLICATION OF MAYER'S THEORY TO THE STUDY OF ONE DIMENSIONAL SYSTEMS WITH REPULSIVE AND WEAK, LONG RANGE INTERACTIONS
Alan J. Liebman and Jean-Yves Parlange Mar. 1970 32 p refs
(Contract Nonr-609(47))
(AD-709373; Rept-16) Avail: NTIS CSCL 7/4

Mayers theory is applied to systems with infinitely repulsive (hard rod) and weak, long range pair potentials. Infinite sets of irreducible integrals are found analytically for each case. A theorem on star graph degeneracies is derived from the hard rods solution. The addition of weak attraction to hard repulsion is shown to give rise to a van der Waals equation of state. When a cluster-width dependent potential is examined, it is found that a region of relatively soft repulsion acts like a weak attraction. Author (TAB)

N70-41248# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
THE THREE-BODY COMBINATION AND DISSOCIATION OF DIATOMIC MOLECULES: A COMPARISON BETWEEN THEORY AND EXPERIMENT
Ven H. Shui, John P. Appleton, and James C. Keck Apr. 1970 51 p refs *Its* Fluid Mech. Lab. Publ. No. 70-3
(Contract N00014-67-A-0204-0040; ARPA Order-322)
(AD-708398) Avail: NTIS CSCL 7/4

The modified phase-space theory of reaction rates was used to predict the three-body recombination and dissociation rate coefficients of the diatomic gas molecules: H2, N2, O2, F2, Cl2, Br2, I2, HF, HCl, CO, and NO in the presence of argon as a collision partner. The ability of the theory to quantitatively predict and correlate both low temperature recombination rate measurements and high temperature dissociation rate measurements is substantial. The success of the theory clearly illustrates the importance of the weak attractive forces between the recombining atoms and argon atoms for recombination at low temperatures, the marked reduction in the rates at high temperatures due to nonequilibrium distributions in the vibrational state populations of the molecules, and the major contributions to reaction progress via electronically excited molecular states at all temperatures for such molecules as N2 and CO. Author (TAB)

N70-41250# ARO, Inc., Arnold Air Force Station, Tenn.
A CLASSICAL MODEL FOR GAS-SURFACE INTERACTIION Final Report, Jul. 1969 – Mar. 1970
M. R. Busby, J. D. Haygood, and C. H. Link, Jr. AEDC Jul. 1970 55 p refs
(Contracts F40600-69-C-0001; F40600-71-C-0002)
(AD-708718; AEDC-TR-70-131) Avail: NTIS CSCL 7/4

A classical theoretical model for gas-surface interaction has been formulated and tested using the experimental data for the gaseous-argon, solid-argon system. The theoretical interaction is modeled as the collision of hard spheres with the inclusion of surface temperature and an attractive surface field energy which is the only adjustable parameter in the formulation. The theoretical results from this exceedingly simple model exhibit nearly every characteristic of the available experimental data for argon. Several general conclusions about the actual argon-argon interaction were made. First, classical mechanics appeared to provide a useful

description for the interaction. Second, a hard sphere model was adequate to predict the gas-solid collision properties over the range of experimental conditions although the theoretical spatial distributions are narrower than those experimentally measured. Third, in order to match the experimental capture coefficient data, the magnitude of the surface field energy was nearer the heat of sublimation rather than the Lennard-Jones or Morse potential well-depth values. Author (TAB)

N70-41251# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

CONDUCTION DOMAINS FOR SOLID ELECTROLYTES

John W. Patterson Feb. 1970 21 p refs Submitted for publication

(Contract F33615-68-C-1034)

(AD-708627; ERI-65300) Avail: NTIS CSCL 20/12

The proposed use of solid oxide electrolytes for determining oxygen concentrations in liquid metals has motivated much research of solid electrolyte properties over wide ranges of chemical potential and temperature. A useful scheme for assessing the electrolytic properties of solid electrolytes is that of plotting electronic and electrolytic conduction domains simultaneously with proposed application domains on chemical potential vs 1/T diagrams. Accordingly, the concept and theoretical origins of conduction domains for solid electrolyte materials are outlined briefly. The solid electrolyte materials AgBr, AgI, CuBr, CuI, CuCl, CaF2, Zr(0.85)Ca(0.15)O(1.85), and Th(0.85)Y(0.15)O(1.925) are discussed. Apparently controversial implications and trends as well as conflicting data interpretations are pointed out. Author (TAB)

N70-41257# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.

CONTRIBUTION TO THE PHOTOMETRIC DETERMINATION OF MAGNESIUM [BEITRAEGE ZUR PHOTOMETRISCHEN MAGNESIUMBESTIMMUNG]

Holger Kuchenbecker (Ph.D. Thesis) 1968 59 p refs In GERMAN

Avail: NTIS

Techniques for the photometric determination of the presence of magnesium are explained. The materials used for dyes, the effect of impurities, and the test equipment used are described. The proposed technique is compared with other processes to indicate areas of improvement. The results of the research are presented in graphs and tables. Transl. by P.N.F.

N70-41259# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.

CONTRIBUTIONS TO PLATINIC(IV) ACID AND THE BEHAVIOR OF ALKALI HEXAHYDROXO PLATINATE(IV) IN AQUEOUS SOLUTIONS [BEITRAEGE ZUR PLATIN(IV)-SAEURE UND ZUM VERHALTEN DER ALKALIHEXAHYDROXOPLATINATE(IV) IN WAESSERIGEN LOESUNGEN]

Annemarie Anke (Ph.D. Thesis) 1968 105 p refs In GERMAN

Avail: NTIS

The processes of preparing platinic(IV) acids described in the literature are analyzed and an easily reproducible method is developed for preparing such acids from metallic platinium or platinum(IV) chloride. A platinic(IV) acid of the stoichiometric compound PtO2 4H2O in crystalline form is obtained by separation from aqueous alkali hexahydroxo platinate(IV) solutions with carbon dioxide or acetic acid and acetone or freeze drying. The thermal behavior, the crystal structure, and the chemical behavior of the compounds are compared with hydroxide and acid solutions. Uthium, magnesium, calcium, strontium, and barium platinate(IV), as well as platinic(IV) acid and solutions of alkali hexahydroxo platinate(IV) are produced and Debye grams are plotted for the preparations in crystalline form. Transl. by R.B.

N70-41278# Army Missile Command, Redstone Arsenal, Ala. Advanced Research Projects Div.

ANOMALOUS WATER

Barry D. Allan and Ralph L. Norman 1 Jun. 1970 20 p refs (AD-708873; RN-TR-70-2) Avail: NTIS CSCL 7/4

Of the many anomalies reported for water, the study concentrated on those anomalous properties exhibited by three types of material--the bound water in animate nature, the interfacially or structurally ordered water in inanimate nature, and the anomalous water (superwater, polywater, orthowater, etc.) produced in the laboratory. In the cells of living tissues there exists a structure of water that reduces the freezing point temperature and is apparently so closely bound in some instances as to be a part of the cell structure rather than just interfacial to the structure. Among inanimate objects there is ample evidence that water is highly ordered in small capillaries, between closely spaced surfaces, and in gels and clays. The anomalous water produced in the laboratory is prepared at an interface and seems highly dependent on the surface. The properties reported for this material--increase in viscosity, reduction in freezing point, increase in boiling point, and reduction in vapor pressure--are the same as those reported for ordered water found at other interfaces. It is believed that the laboratory anomalous water, like that found in nature, is interfacial in structural makeup and will revert to ordinary water soon after removal from its interfacial formation sites. Author (TAB)

N70-41284# Technische Univ., Berlin (West Germany). Fakultaet fuer Bergbau und Huettenwesen.

CONTRIBUTION OF OXIDATION TO THE FUSING OF IRON-CARBON-SILICON COMPOUNDS [BEITRAG ZUR OXYDATION VON EISEN-KOHLENSTOFF-SILICIUM-SCHMELZEN]

Karl Eugen Hoener (Ph.D. Thesis) 1968 109 p refs In GERMAN

Avail: NTIS

The effect of oxidation on the fusing of iron-carbon-silicon compounds is discussed. The chemical reactions, microstructure, thermodynamic properties, and test procedures are described. Transl. by P.N.F.

N70-41286# Technischen Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.

THE REPEATING TEMPERATURE JUMP EXCITATION OF REACTIONS IN NICKEL COMPLEXES [DIE REPETIERENDE TEMPERATURSPRUNGANREGUNG VON REAKTIONEN AN NICKELKOMPLEXEN]

Peter Brumm (Ph.D. Thesis) 1968 77 p refs In GERMAN

Avail: NTIS

Research on the properties of solutions with high ionic strength is described. The construction of a temperature jump measuring apparatus using microwave impulses is presented. The apparatus is used to determine the temperature variations which occur during the chemical reactions involved in the formation of complex nickel compounds. Transl. by P.N.F.

N70-41315# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.

ADSORPTION EXCHANGE OF ONE VALENCE CATIONS ON HEAVY METAL-HEXACYANO FERRATES (II) [AUSTAUSCHADSORPTION EINWERTIGER KATIONEN AN SCHWERMETALL-HEXACYANOFERRATEN (II)]

Juergen Schneider (Ph.D. Thesis) 1968 71 p refs In GERMAN

Avail: NTIS

The exchange behaviors of hexacyano ferrates (II) of nickel, cobalt, copper, zinc, and lead were compared with cesium, rubidium, potassium, sodium, litium, strontium, barium, and tellurium. Concentration dependences of ion exchanges and pH values were measured and the exchange capacities were determined. Results show that less than 50% of heavy metal ions can be exchanged

with one valence ions. Isotope exchange reactions on pure heavy metal-hexacyano ferrates of cobalt, zinc, and on cesium enriched hexacyano ferrates of nickel, copper, cobalt, and zinc were also performed and a partial fixation of cesium was observed. Differing capacities of the investigated ions were attributed to differently strong hydration behavior. Transl. by G.G.

N70-41317 Technische Univ., Berlin (West Germany).
THE HIGH TEMPERATURE SULFATION OF TUNGSTEN AND MOLYBDENUM IN HYDROGEN/HYDROGEN SULFIDE MIXTURES AND IN SULFURIC VAPOR [DIE HOCHTEMPERATURSCHWEFELUNG VON WOLFRAM UND MOLYBDAEN IN WASSERSTOFF-SCHWEFELWASSERSTOFF-GEMISCHEN UND IN SCHWEFELDAMPF]
Hans-Joachim Hamel (Ph.D. Thesis) 1968 64 p refs In GERMAN
Avail: NTIS

Continuous sulfations of tungsten and molybdenum samples in a hydrogen/hydrogen sulfide stream were measured by weight increases in correlation with gas composition and temperature. The formative conditions for sulfide layers were discussed and compared with oxidative surface layers. Tungsten orientation determined layer growth thickness and tungsten structure affected sulfation velocity. Both effects were not observed in molybdenum sulfation. Diffusion coefficients of the tungsten sulfide were 10 times larger than those of molybdenum sulfide. Transl. by G.G.

N70-41347# Technische Univ., Berlin (West Germany).
ON THE OXIDATION VELOCITY OF ALUMINUM IN CRYOLITE MELTS [UEBER DIE GESCHWINDIGKEIT DER OXYDATION DES ALUMINIUMS IN KRYOLITH-SCHMELZEN]
Jobst Weber (Ph.D. Thesis) 1969 37 p refs In GERMAN
Avail: NTIS

Aluminum diffusion velocities in pure cryolite and in cryolite containing 12% Al203 at 1000 C were determined gravimetrically. Oxidation time-velocity fluctuations in melts with and without aluminum reservoir were attributed to carbon dioxide flow over the melt; oxidation velocity was measured by the content of CO/CO2 in the rising vapor flow. Obtained results established that metal diffusion in electrolyte determined the reoxidation velocity of aluminum. Oxidation after completed diffusion is a reaction of first order. Transl. by G.G.

N70-41364# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
SYSTEMATIC SPECTROPHOTOMETRIC RESEARCH OF FLUORINES AND THEIR METAL COMPOUNDS [SYSTEMATISCHE SPEKTRALPHOTOMETRISCHE UNTERSUCHUNGEN VON FLUORONEN UND IHREN METALLKOMPLEXEN]
Klaus Henning Brandt (Ph.D. Thesis) 1968 121 p refs In GERMAN
Avail: NTIS

The determination of the physical and chemical properties of fluorine and fluorine compounds by spectrophotometry is described. The test equipment used and the procedures for conducting the analysis are presented. Results of the research are provided in tables and graphs. Transl. by P.N.F.

N70-41390*# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
STUDIES IN FUNDAMENTAL CHEMISTRY OF FUEL CELL REACTIONS Quarterly Report, 1 Apr. -30 Jun. 1970
John O'M. Bockris Jun. 1970 19 p refs
(Grant NGR-39-010-002)
(NASA-CR-113916; QR-6) Avail: NTIS CSCL 07B

The rate of the oxygen dissolution reaction is calculated theoretically and the properties of the metal electrode on which the rate of the reaction depends most are investigated. The model to be used in the calculation is formulated and a rough calculation of the activation energy values is made. Methods of preventing dendrite growth and of decreasing the active surface on the zinc electrode are discussed. Organic adsorption in the crystallization process is considered with respect to dendrite growth inhibition. R.B.

N70-41521# Boeing Scientific Research Labs., Seattle, Wash. Polymer Sciences Lab.
THERMAL ANALYSIS OF A POLYPHENYL-AS-TRIAZINE
W. J. Wrasidlo and P. M. Hergenrother Jun. 1970 26 p refs Submitted for publication
(AD-709353; D1-82-0978) Avail: NTIS CSCL 7/3

A well-characterized poly(phenyl-as-triazine) was pyrolysed under dynamic and isothermal conditions in vacuum and in air. Simultaneous thermogravimetric, differential thermal and thermobarometric analysis of polymer films indicate a multistage thermal decomposition. An exothermic reaction between 305 and 465C was shown to involve the asymmetric triazine ring. This leads to the formation of a stable intermediate symmetrical triazine and nitrilic products, primarily benzonitrile. Based on the data, a degradation scheme initially involving the scission of the nitrogen-nitrogen bond in the asymmetric triazine ring was postulated. Author (TAB)

N70-41548# Aerospace Corp., El Segundo, Calif. Lab. Operations.
A SHOCK TUBE STUDY OF H2 + SF6 REACTIONS
Jerry F. Bott 15 Aug. 1970 27 p refs
(Contract F04701-70-C-0059)
(AD-709724; TR-0059(6816-36)-1; SAMSO-TR-70-266) Avail: NTIS CSCL 7/4

Shock tube studies have been made of SF6 dissociation in the presence of H2 at temperatures between 1734 and 1848K and pressures of about 1 atm. During the reaction, SF6 concentration was monitored with measurements of the IR emission at 11.0 microns. The measurements with and without H2 were the same within the experimental error, indicating that H2 is no more effective than argon in dissociating SF6. Spectroscopic measurements of the spectral profile of the 10.6 micron band of SF6 indicated a shift in the maximum intensity from 10.6 microns at room temperature to 11.0 microns at 1780K. Author (TAB)

N70-41561# RAND Corp., Santa Monica, Calif.
RAND'S CHEMICAL COMPOSITION PROGRAM: A MANUAL
Marian Shapley and Leola Cutler Jun. 1970 227 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-709173; R-495-PR) Avail: NTIS CSCL 7/4

A users manual is provided for Rands digital computer program for solving complex chemical composition problems by determining the distribution of chemical species in multicompartmented systems that minimizes the free energy of the system while conserving the mass of each chemical component. The total program, containing more than 35 subprograms, is flexible. During a run, the user may alter the data--e.g., add extra amounts of some chemicals (stresses), thus changing the models composition and creating a new problem. He may also control some constants, cause computation and printing of certain measures of amount of error, and request various special computations and messages. Finally, the program may be used by either experienced computer programmers or those unfamiliar with programming methods because, first, the user refers to the data elements by easily remembered alphanumeric names and, second, he gives operation instructions by control cards containing one alphanumeric word. Author (TAB)

N70-41569# California Univ., Livermore. Lawrence Radiation Lab.
ANALYTICAL CHEMISTRY Annual Report, 1969
J. E. Harrar, comp. 8 Apr. 1970 71 p refs
(UCRL-50006-70) Avail: NTIS

A summary is presented of the unclassified research and development activities in analytical chemistry during 1969. Topics discussed include computer-automated methods for mass spectrometry, vacuum fusion analyses, atomic absorption spectrophotometry, and spectrographic plate reading; surface analysis techniques involving Auger and spark source mass spectrometry; studies in emission, microwave, X-ray fluorescence, luminescence, and electron microprobe spectroscopy; minicomputer software development and applications; wet chemical methods for organic and inorganic substances; controlled-potential coulometry; gas chromatography; high resolution mass spectrometry; methods for the determination of moisture in rocks by microwave spectroscopy and calorimetry; and the application of these techniques to specific problems of the laboratory. Author (NSA)

N70-41571# National Bureau of Standards, Washington, D.C. Activation Analysis Section.
ACTIVATION ANALYSIS SECTION: SUMMARY OF ACTIVITIES, JULY 1968 – JUNE 1969
Philip D. La Fleur, ed. Jul. 1970 147 p refs
(NBS-TN-508) SOD $1.25 Catalog No. C13.46:508

The design and installation of irradiation facilities for the NBS Reactor are described with procedures for determining molybdenum in the presence of large amounts of tungsten. Activation analysis with a nuclear reactor, the Cockcroft–Walton neutron generator, and the NBS Linac is discussed. Developments in radiochemical separation are presented. F.O.S.

N70-41623# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
ON THE EFFECT OF OXYGEN ON XENON DIFFUSION IN URANIUM DIOXIDE [UEBER DEN EINFLUSS DES SAUERSTOFFS AUF DIE DIFFUSION VON XENON IN URANDIOXYD]
Wolfgang Miekeley (Ph.D. Thesis) 1968 86 p refs In GERMAN
Avail: NTIS

The transport of noble gases in moving trivacancies of uranium oxide crystals of known oxygen content is studied by measuring oxygen emission after activation as a function of temperature and initial partial oxygen pressure. The obtained activation enthalpy is the motion enthalpy of the trivacancy that contains the noble gas atom. The difference between activation enthalpies of xenon diffusion in UO2 and UO2(+x) delivers the energy required for the release of the movable complex from the trap. Transl. by G.G.

N70-41625# Colorado State Univ., Fort Collins. Dept. of Chemistry.
ELECTROCAPILLARY MEASUREMENTS IN THE PRESENCE AND ABSENCE OF SUPERIMPOSED ac POTENTIAL
John Lawrence and David M. Mohilner 1 Jul. 1970 19 p refs Submitted for publication
(Contract N00014-67-A-0299-0007)
(AD-709448; TR-2) Avail: NTIS CSCL 7/4

Recent discussions on the discrepancies which exist between double layer adsorption parameters determined from electrocapillary measurements and differential capacitance measurements are considered. Electrocapillary curves have been determined by the classical method of maximum bubble pressure recommended by Schiffrin. An electronic detector has been added using a.c. signal across the interface to determine the instant when the first mercury droplet begins to grow. Comparison of curves obtained by visual and electronic detection shows that, within experimental error, the a.c. has no effect on the measured interfacial tension. It is concluded that the commonly observed discrepancies arise from a finite, changing contact angle at the mercury-glass-solution interface in the Lippmann capillary electrometer. Author (TAB)

N70-41738*# Pennsylvania State Univ., University Park. Center for Air Environment Studies.
CYCLED OPERATION OF WATER VAPOR ELECTROLYSIS CELL Annual Report, 1 Jan. – 31 Dec. 1969
A. J. Engel and A. M. Bloom 1 Mar. 1970 70 p refs
(Grant NGR-39-009-123)
(NASA-CR-113868; CAES-Publ-159-70) Avail: NTIS CSCL 07D

A rigorous mathematical model representing the heat, mass, and momentum relationships was developed for digital computation. However, the modeling process revealed a number of gaps in the data previously obtained for the cell. Therefore, it was decided that before any further cycling work would be carried out, these gaps had to be filled. Experimental studies to determine the equilibrium conditions that exist between the gel matrix and water vapor as a function of acid concentration in the matrix were conducted satisfactorily. Also, the electrical conductance of the matrix was studied for varying silica concentrations. Finally, the cell hardware components for the cyclic operation studies were built and/or assembled and are now operational. Author

N70-41775# Wisconsin Univ., Madison. Dept. of Chemistry.
NOVEL ORGANOMETALLIC COMPOUNDS Final Report, 1 Mar. 1969 – 28 Feb. 1970
Robert West Arlington, Va. AFOSR Feb. 1970 9 p
(Contract AF-AFOSR-1772-69)
(AD-709684; AFOSR-70-2027TR) Avail: NTIS CSCL 7/3

The compound C_5Li_4 was synthesized from methyldiacetylene and n-butyllithium. Reaction of C_5Li_4 with trimethylchlorosilane yielded tetrakis(trimethylsilyl)pentadienevne, a possible monomer for heat-stable polymers. The first cage polysilane permethyloctasilabicyclo-2,2,2-octane, was prepared. Acetonitrile was lithiated to Li2CHCN, which reacts with chlorosilanes to give novel trisilylynamines. A new anionic rearrangement reaction of alkoxysilanes to silylcarbinol anions was discovered. Author (TAB)

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N70-40423 IIT Research Inst., Chicago, Ill.
ANALYSIS OF CONSTANT FALSE ALARM PROBABILITY RADAR SYSTEM TECHNIQUES
John Dabkowski, Jr. (Ph.D. Thesis) 1969 228 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 69-19085

Techniques are investigated to enable constant false alarm probability operation in a pulse Doppler radar receiver in the presence of a nonstationary clutter background. The specific situation considered is that of an airborne radar system operating over land, and, hence, subject to ground clutter returns entering the receiver through the main beam and side-lobes of the antenna. The nonstationary aspects of the problem are introduced by the fact that ground clutter is spatially nonhomogeneous and that the radar platform is moving relative to the ground. Solutions to the problem

are obtained through the techniques of statistical decision theory. Specifically, similar (critical) region and scale invariant likelihood ratio test constructions are utilized. Use of these techniques allows maintenance of a constant false alarm probability independently of the mean clutter power level. Dissert. Abstr.

N70-40424 + British Broadcasting Corp., Kingswood (England). Research Dept.

PULSE-CODE MODULATION FOR HIGH-QUALITY SOUND SIGNAL DISTRIBUTION: FEASIBILITY OF MULTIPLEX SYSTEM

J. R. Chew Sep. 1970 7 p refs

(BBC-1970/34) Avail: NTIS

The feasibility was investigated of applying p.c.m. to the distribution of stereophonic programs of the highest broadcast quality in time-division multiplex. By this means all the programs required for the various radio services could be carried over a single wide-band link. Experimental equipment comprising a 14-bit coder and decoder, together with a 13-channel multiplexer and demultiplexer was developed for this purpose. The equipment functioned as predicted, and, while the amount of disturbance suffered by the sound signal when faults occur on the link could be reduced by further development, the practicability of the system as a whole is proved. Author

N70-40425+ British Broadcasting Corp., Kingwood (England). Research Dept.

VHF RECEIVING AERIALS: THE USE OF ACTIVE ELEMENTS

D. J. Whythe Sep. 1970 17 p refs

(BBC-1970/31) Avail: NTIS

An array of half-wavelength dipoles formed the most convenient type of aerial for VHF television rebroadcast reception. The difficulty was overcome by incorporating an amplifier directly across the terminals of each dipole such that the dipoles operate under substantially open-circuit conditions. A suitable design for a practical active dipole is described and, as an example, the directivity that could be achieved using an array of eight such dipoles is given. Author

N70-40432 + British Broadcasting Corp., Kingswood (England). Research Dept.

MULTIPLE WALL WEATHERSHIELDS FOR UHF AERIALS

C. D. Mathers Sep. 1970 8 p ref

(BBC-1970/33) Avail: NTIS

Calculations were made of the effective reflection coefficient, as a function of frequency, of cylindrical weathershields comprising one, two or three dielectric walls. The effect of a dielectric infill between the walls is also considered. Author

N70-40449# Aerospace Corp., El Segundo, Calif. Office for Development Planning

SATELLITE SYSTEMS FOR INTEGRATED COMMUNICATIONS, NAVIGATION, AND IDENTIFICATION

P. M. Diamond 15 Feb. 1970 15 p refs

(Contract F04701-69-C-0066)

(AD-708469; TR-0066(5521-01)-5; SAMSO-TR-70-160) Avail: NTIS CSCL 22/2

Integrated Communications, Navigation, and Identification (ICNI) implies two objectives: (a) implementation of a worldwide available command/control system, and (b) equipment and signal integration. Satellite systems can provide navigation capability, and communications capability. Tactical satellite communications experiments have demonstrated feasibility; however, ICNI requirements dictate a wideband, high power, and large, expensive satellite. This satellite is developable during the latter 1970s. The navigation capability requires development and demonstration in the near future. Author (TAB)

N70-40461 National Lending Library for Science and Technology, Boston Spa (England).

A SOLID-STATE SOUND AND VISION EXCITER FOR HIGH POWER TELEVISION TRANSMITTERS

P. Chiantore et al 29 May 1970 23 p Transl. into ENGLISH from 14th Intern. Congr. on Electron. (Rome), v. 1, 1967 p 827-837 In ENGLISH and ITALIAN

(NLL-M-9135-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Transistorized exciters for power amplifiers in television transmitters are discussed in terms of developing a standard unit, fully transitorized for use as a driver for any power amplifier, able to correct distortion, and with the capability of color transmission. The problems in designing this unit are given, and for simplification the driver is examined in three functional parts. These are: (1) carrier generator, (2) audio driver (or preamplifier), and (3) video driver. F.O.S.

N70-40491 Michigan Univ., Ann Arbor.

ANTENNA SIDELOBE AND COUPLING REDUCTION BY MEANS OF REACTIVE LOADING OF THE GROUND PLANE

Constantine John Digenis (Ph.D. Thesis) 1969 163 p

Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-17991

The loading of the ground plane by a capacitive impedance is investigated as a method of reducing the sidelobes of one antenna and the coupling between adjacent antennas. Although in the analysis no restrictions are placed upon the frequency, practical considerations regarding the loading make this method particularly suitable for antennas operating in the microwave region of the spectrum. Explicit expressions are derived for the directivity and radiation resistance of a monopole placed over an infinite sheet characterized by a capacitive surface impedance. Also the problem of a short monopole over an infinite screen which is perfectly conducting throughout except for an annulus of capacitive surface impedance is considered and closed form expressions are obtained for the far zone field by an approximate method. Numerical results show that there is an optimum position for an annulus of a given radial extent in order to achieve maximum antenna gain and minimum radiation along the ground plane. Dissert. Abstr.

N70-40522 + British Broadcasting Corp., Kingswood (England). Research Dept.

AN INVESTIGATION INTO THE PREDICTION OF FIELD STRENGTH: THE GUILDFORD EXPERIMENT

R. W. Lee, J. H. Causebrook, and R. S. Sandell Aug. 1970 20 p refs

(BBC-1970/26) Avail: NTIS

A preliminary investigation into the prediction of field strength, of both wanted and interfering signals, at uhf is summarized. Terrain data for an area 25 miles (40 km) in diameter centered on Guildford were stored in the computer and used for the prediction of field strengths by various methods. The results were compared with detailed measurements of five transmissions in the Guildford area. The results demonstrate that existing methods of interference prediction require improvement, and that the prediction of wanted and interfering signals ought to be combined. Author

N70-40523 + British Broadcasting Corp., Kingswood (England). Research Dept.

SATELLITE BROADCASTING: AN AERIAL DESIGN FOR DOMESTIC RECEPTION IN THE 12 GHz BAND

G. H. Millard Aug. 1970 9 p refs
(BBC-1970/27) Avail: NTIS

The design of an aerial suitable for use in television band 4 (11.7 GHz – 12.7 GHz) is described. Author

N70-40600 Auburn Univ., Ala.
AN ANALYSIS OF A 35 GHz COMMUNICATION DOWNLINK FROM A STATIONARY SATELLITE
Fred Alan Ford (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-18637

A generalized analysis of a 35 GHz communication downlink is carried out by calculating the anticipated carrier power-to-noise density ratio. The factors contributing to this ratio are enumerated and evaluated in a manner intended to allow extension of results to various system configurations and varying system parameters. The effects of clouds, rain, water vapor, and molecular oxygen are taken into account as loss factors which are functions of path length through the troposphere. Ionospheric dispersion, absorption, and polarization characteristics are investigated, as are noise sources internal and external to the system. A survey of modulation methods, both analog and digital, is presented. The relative import of the various limiting factors and their ranges of variation are assessed. Space-diversity reception as a means of reducing system outage time is investigated with earth-coverage being considered the limiting case of this configuration. Dissert. Abstr.

N70-40627*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REFLECTION COEFFICIENTS OF PYRAMIDAL AND H-PLANE HORNS RADIATING INTO DIELECTRIC MATERIALS
C. R. Cockrell Washington Sep. 1970 50 p refs
(NASA-TN-D-5978; L-7203) Avail: NTIS CSCL 09E

The admittance of a uniform rectangular waveguide-fed aperture is assumed to approximate the mouth admittances of the pyramidal and H-plane horns. Calculations of the admittances (or reflection coefficients) were obtained for the rectangular-mouth sizes of the pyramidal and H-plane horns under free-space conditions and with the horns radiating into slabs of plexiglass or quartz. The results of the study indicate that the expressions for the admittance of a uniform rectangular waveguide-fed aperture can be used to approximate the mouth admittances of the pyramidal and H-plane horn. The accuracy of this approximation is similar to that obtained with rectangular waveguides opening onto small ground planes covered with slabs of material. The admittance of a uniform rectangular waveguide-fed aperture is shown to approach the admittance of a parallel-plate waveguide radiating into a slab of homogeneous material as the long dimension of the aperture becomes infinite. This result is shown both analytically and numerically (for free-space conditions) for the dominant mode. Author

N70-40651 California Univ., Los Angeles.
MULTIPLE-ARM CONICAL LOG-SPIRAL ANTENNAS
Ali Ezz El-Din Atia (Ph.D. Thesis) 1969 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-18877

The objectives are to obtain an accurate solution to the current distribution on multiple-arm conical log-spiral antennas, to investigate their operation under different excitation conditions, and to provide simple, quick means of designing practical antennas of this type. The integral equation method is used in the analysis. The numerical solution of the integral equation is programmed for a digital computer. The method of sinusoidal interpolation of the current is used, by which antennas of lengths up to 10 wavelength can be analyzed. An efficient representation of the current distribution is obtained. A numerical method and an iterative process are developed to obtain the complex eigenvalues and the homogeneous boundary condition at the input of the antenna. Curves relating the eigenvalues and the expansion coefficients of the eigenfunctions to the antenna parameters are obtained. A method is described for the determination of the antenna phase center numerically. Dissert. Abstr.

N70-40692# Stanford Univ., Calif. Dept. of Computer Science.
SPEECH ANALYSIS BY CLUSTERING, OR THE HYPERPHONEME METHOD
M. M. Astrahan May 1970 24 p refs
(Contract ARPA SD-183)
(AD-709067) Avail: NTIS CSCL 17/2

Measured speech waveform data was used as a basis for partitioning an utterance into segments and for classifying those segments. Mathematical classifications were used instead of the traditional phonemes or linguistic categories. This involved clustering methods applied to hyperspace points representing periodic samples of speech waveforms. The cluster centers, or hyperphonemes (HPs), were used to classify the sample points by the nearest-neighbor technique. Speech segments were formed by grouping adjacent points with the same classification. A dictionary of 54 different words from a single speaker was processed by this method. 216 utterances, representing four more repetitions by the same speaker each of the original 54 words, were similarly analyzed into strings of hyperphonemes and matched against the dictionary by heuristically developed formulas. 87% were correctly recognized, although almost no attempt was made to modify and improve the initial methods and parameters. Author (TAB)

N70-40741# Pennsylvania State Univ., University Park. Ordnance Research Lab.
AN INVESTIGATION OF DIGITAL TECHNIQUES FOR OBTAINING CORRELATION ENVELOPES
J. H. Beebe Washington Naval Ordnance Systems Command 5 Jan. 1970 120 p refs
(Contract N00017-70-C-1407)
(AD-707801; TM-867-02) Avail: NTIS CSCL 9/4

A problem considered was that of obtaining the envelope of the output of a clipped input digital correlator, an input consisting of a deterministic, hard-limited signal, buried in Gaussian noise. The problem arises from the fact that sampling the input is initiated at some random input phase angle, thus causing the output to be down from its theoretical peak value. The correlator employs a type of sampling commonly used with bandpass signals, a sampling of the signal and its quadrature. With this type of sampling, two outputs, after summing, should produce the envelope peak, independent of the input phase. This was tried experimentally with the following results: (1) The sin square x detection procedure does give the correlation envelope peak, for infinite signal-to-noise ratio, independent of phase shift between input signal and reference. (2) For finite signal-to-noise ratios from -5 dB to +5 dB, the detection procedure gives the mean envelope peak with a periodic variation as the input phase shift is varied from 0 to -90 degrees. The variation, 8% of full scale, is due to the chosen ratio of carrier frequency to sampling frequency. (3) The correlation envelope lies between erf the square root of (S/2N) and (S/N) divided by (1 + S/N), where S/N is the signal-to-noise ratio. Author (TAB)

N70-40761# Stanford Univ., Calif. Radioscience Lab.
SPATIAL PROPERTIES OF IONOSPHERIC RADIO PROPAGATION AS DETERMINED WITH HALF-DEGREE AZIMUTHAL RESOLUTION
L. E. Sweeney, Jr. Jun. 1970 103 p refs
(Contract Nonr-225(64); ARPA Order 196)
(AD-709069; TR-155; SU-SEL-70-034) Avail: NTIS CSCL 17/2

The purpose of the research was to investigate experimentally the properties of oblique ionospheric radio propagation which could

degrade or limit the performance realized by a very wide-aperture (2.5 km), high-frequency broadside array. High-frequency (HF) refers to the frequency band from 3 MHz to 30 MHz. A broadside antenna array is one whose main lobe direction is roughly perpendicular to the line of its elements. Since the performance of such an array can most meaningfully be measured in terms of its horizontal pattern (beamwidth and sidelobe levels), the emphasis of this study was upon the apparent azimuthal pattern of an array when receiving ionospherically propagated radio energy emanating from a point source. Author (TAB)

N70-40817# Aerospace Corp., El Segundo, Calif. Lab. Operations.
TERRAIN BACKSCATTER MEASUREMENTS AT 40 TO 90 GHz, REPORT FOR 1968–1969
Howard E. King and Charles J. Zamites 15 Jun. 1970 38 p refs
(Contract F04701-69-C-0066)
(AD-708463; TR-0066(5816-41)-1; SAMSO-TR-70-220) Avail: NTIS CSCL 17/9

Experimental measurements were made under controlled laboratory conditions to determine terrain backscatter in the 40- to 90-GHz frequency range. Terrain samples in a dry and wet condition included asphalt, concrete, gravel, wood, sod, and tall weeds. Smooth and rough water were also included. Author (TAB)

N70-40923# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THE RADIATION EFFICIENCY OF ELECTRICALLY SMALL MULTITURN LOOP ANTENNAS Interim Technical Report
Glenn Smith Jun. 1970 36 p refs
(Contract N00014-67-A-0298-0005)
(AD-709154; TR-612) Avail: NTIS CSCL 9/5

The radiation efficiency of electrically small multiturn loop antennas is examined. Both the normal skin effect loss and the additional loss due to the close proximity of adjacent loop turns are considered. The case of the two turn loop with skin effect and proximity losses is considered in detail and the results are compared with those for the same loop where proximity effects are neglected. Author (TAB)

N70-40957*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MULTIPLEX DATA BUS TECHNIQUES
Walter O. Frost *In its* Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 91–94 (See N70-40951 23-31)
Avail: NTIS CSCL 17B

The application of data bus techniques in the space shuttle provides potential improvements in size and weight, flexibility, and reliability. The general requirements for a space shuttle data bus are described, and critical technology considerations are discussed. Some design alternatives for transmission media, signal design, synchronization and control, input/output interfaces, and operational reliability are described. Author

N70-40958*# TRW Systems, Redondo Beach, Calif.
DATA BUS DESIGN TECHNIQUES
Donald J. Spencer *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 95-113 refs (See N70-40951 23-31)
Avail: NTIS CSCL 17B

The design considerations for a multiplex data bus subsystem in space shuttle vehicles are discussed. The selection of the modem and transmission medium in the digital system is considered. Sample systems reflecting signal-to-noise ratios and data rate are summarized. R.B.

N70-40969*# Airborne Instruments Lab., Inc., Melville, N.Y.
AN ALL-SOLID STATE, S-BAND PARAMP UTILIZING MICROWAVE INTEGRATE CIRCUITS
P. H. Dalle Muka (NASA. Goddard Space Flight Center) *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 289–294 (See N70-40951 23-31)
(Contract NAS5-10657)
Avail: NTIS CSCL 17B

An all solid state parametric amplifier developed for use aboard a data relay satellite in synchronous orbit is described. The paramp is a wide instantaneous bandwidth, low noise unit which utilizes a Gunn device oscillator as a pump source and a hybrid microwave integrated circuit in the circulator-paramp section. Some of the difficulties encountered in the application of microstrip circuitry to the paramp components are described. Selection of the type of solid state pump oscillator based on paramp noise performance is discussed. Test results measured on the paramp are presented. Author

N70-40983# Army Foreign Science and Technology Center, Washington, D.C.
A METHOD FOR CALCULATING THE CURRENT DISTRIBUTION IN A SYSTEM OF LINEAR BIPOLES AND OF THE RADIATION PATTERN IN SUCH A SYSTEM
A. N. Tikhonov et al 14 Apr. 1970 9 p refs Transl. into ENGLISH from Vychislitelnyi Tsentr. Sb. Rabot (Moscow); no. 10, 1968 p 3–8
(AD-709614; FSTC-HT-23-261-70) CSCL 20/14

The calculation methods for linear vibrators have considerable significance in the development of antenna theories as well as for applied antenna technics in the development of antenna systems with a required radiation pattern. The calculation of the radiation pattern with given currents in the vibrators does not present any difficulties. This is a matter of computing single integrals. A somewhat more difficult problem is the calculation of currents in a system of linear vibrators with the computation of their interaction influence. For this question, at the present time there are no known methods of solving these problems. The key to the situation is contained in the compulsory solving of the integral systems of Fredholm equations of the first order, which is to the incorrect problem. Recent development concerning the solution of incorrect problems allowed the establishment of a stable algorithmic solution of the problem of linear vibrator excitation systems. TAB

N70-40992# Ball Bros. Research Corp., Boulder, Colo.
INSTRUMENTATION AND FLIGHT OF SOLAR POINTING CONTROL SPC 204 AND TELEMETRY SYSTEM TEL 335 WITH NRL AEROBEE NF 3.193 Final Technical Report
Ralph W. Shook 23 Jun. 1970 15 p
(Contract Nonr-5032(00))
(AD-709102) Avail: NTIS CSCL 9/6

The report contains information concerning the integration and field testing, the flight and subsequent data evaluation, and the performance analysis of Solar Pointing Control SPC 204 and Telemetry System TEL 335 with the NRL flight experiment aboard NRL Aerobee Sounding Rocket. Author (TAB)

N70-41010# Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
AN/PPS-18 (XN-1) ULTRA RELIABLE RADAR Interim Development Report, 1-30 Jun. 1970
J. D. Frattura 8 Jul. 1970 66 p
(Contract N00039-70-C-3502)
(AD-709138) Avail: NTIS CSCL 17/9

The program covers the study, design, construction, test analysis and inspection of a complete and operative, highly reliable,

relatively failure-free version of the pulsed doppler surveillance AN/PPS-6 radar set. The radar set is intended to be a lightweight, miniaturized, X-band, pulse doppler combat surveillance radar.
Author (TAB)

N70-41012 National Lending Library for Science and Technology, Boston Spa (England).
A WIDE-BAND ABSORBER FOR ELECTROMAGNETIC WAVES [BREITBANDABSORBER FUER ELEKTROMAGNETISCHE WELLEN]
J. Deutsch et al 6 Jul. 1970 7 p refs Transl. into ENGLISH from Z. Angew. Phys. (Berlin), v. 11, no. 12, 1959 p 453–455
(NLL-TIL-T.5381-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Construction of shaft absorbers and reflection factor measurements are described, which are also suitable for meter waves. Within a useful relative bandwidth of 1:35 the reflection factor is below 10%. The permissible angle of incidence of the waves rises to over 65 deg with increasing frequency. Methods of reducing the depths of shaft absorbers are discussed, also the possibilities of obtaining reflection factors below 10% for frequencies below the present lower limit.
Author

N70-41030# National Inst. for Telecommunications Research, Johannesburg (South Africa). Radio Space Research Station.
SATELLITE TRACKING ACTIVITIES OF THE JOHANNESBURG STADAN Monthly Report
W. J. Botha Mar. 1970 14 p Prepared for Bendix Corp.
Avail: NTIS

Nonroutine operational activity, centered around preparations, tests, and simulations for the impending Nimbus D launch, is described. Communications section operations and circuit outages, maintenance activities, general logistics support, and administrative problems are reported.
P.A.B.

N70-41053# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
VARIABLE LENGTH PREFIX ENCODING
Benjamin F. Varn, Jr. Jun. 1970 115 p refs
(Contract DAHC04-68-C-0002; Proj. Themis)
(AD-709637; THEMIS-UF-TR-39) Avail: NTIS CSCL 9/4

The problem of constructing minimum-redundancy prefix codes for the general discrete noiseless channel without constraints is considered for unequal code letter costs. Two cases are considered; the symbols encoded are assumed to be equally probable, and the symbols encoded are not restricted to be equally probable. A graphical technique is developed for solving the problem for which the code words are equally probable and are constructed from r symbols where $r > or = 2$. The solution technique is valid either in the presence or absence of the exhaustive constraint. A selective enumeration technique is developed for solving the problem in which the code words are not equally probable and are constructed from $r = 2$ symbols. The computational feasibility of the solution technique is demonstrated.
Author (TAB)

N70-41059*# TRW Systems Group, Redondo Beach, Calif. Electronic Systems Lab.
AN ANALYSIS OF A PREEMPHASIS-DEEMPHASIS TECHNIQUE FOR LCRU TELEVISION
R. J. Pannaton 5 Aug. 1970 156 p refs
(Contract NAS9-8166)
(NASA-CR-108606; TRW-11176-H593-R0-00) Avail: NTIS CSCL 17B

The use of preemphasis/deemphasis to improve the performance of the lunar communications relay unit (LCRU) television system is considered. A theoretical analysis is made of the improvement in video signal-to-noise ratio obtained with the use of signal emphasis on an FM channel, above and below threshold. The theoretical development, construction, and testing of preemphasis-deemphasis networks is also presented. Significant performance improvement is demonstrated by total system tests involving visual assessment of video picture quality. Experimental results indicate a minimum 3 dB RF level improvement, approximately corresponding to a minimum 3.7 dB video SNR improvement, can be achieved using video signal emphasis. Good television picture quality is obtained at −90 dBm, the worst-case total-received RF power level for the LCRU-to-85-foot MSFN station link. In summary, simple preemphasis and deemphasis networks can provide improved LCRU television performance at a modest cost in terms of circuitry. It is recommended, therefore, that video signal preemphasis and deemphasis networks be implemented in the LCRU television system.
Author

N70-41086# Naval Postgraduate School, Monterey, Calif.
DESIGN AND PERFORMANCE OF A TWENTY-CORNER-CLUSTER REFLECTOR
Prokopios Katris (M.S. Thesis) Dec. 1969 70 p refs
(AD-709085) Avail: NTIS CSCL 17/9

The paper is a report on the design and performance of a twenty-corner-cluster (icosahedron) reflector. Comparison of the measured cross sections of the icosahedron reflector with those of a cluster of eight corner reflectors used as a standard reflectors shows the former beign superior in performance over the latter in that it gives nearly omnidirectional response.
Author (TAB)

N70-41137# Chicago Univ., Ill. Lab. for Atmospheric Probing.
THE MEASUREMENT OF POINT TARGET SPEEDS WITH INCOHERENT NON-TRACKING RADAR INSECT SPEEDS IN ATMOSPHERIC WAVES
David Atlas, F. Ian Harris, and Juergen H. Richter (Naval Elec. Lab. Center, San Diego, Calif.) 1 Apr. 1970 38 p refs
(Contract N00014-67-A-0285-0007; Grant NSF GA-10639)
(AD-709409; TR-17) Avail: NTIS CSCL 17/9

A non-doppler method for the determination of the horizontal speeds of point targets crossing a circular radar beam is presented. It requires knowledge only of the range, the relative signal intensity variation with time, and the beam width of the radar. Dot angels, assumed to be insects, with observed 10 cm cross-sections of .00001 to .001 cm squared are found to have speeds from 0.9 to 5.0 m/sec. The high range resolution also permits accurate determination of the target vertical velocities from the time derivative of their height. Vertical velocities were found to range from -0.86 m/sec to +0.75 m/sec. The variation in both vertical and horizontal insect speeds of a selected group of insects correlates very well with the simultaneously observed radar heights of an atmospheric wave at about the same altitude as the insects. Due to a phasing difference it is concluded that the insects are moving in a direction opposite that of the wave perturbation.
Author (TAB)

N70-41206# National Aviation Facilities Experimental Center, Atlantic City, N.J.
NAS EN ROUTE STAGE A, RADAR VIDEO DATA PROCESSOR MODIFICATIONS Final Report, May 1967–May 1970
O. D. Carlson Aug. 1970 32 p
(FAA-NA-70-42; FAA-NS-70-1) Avail: NTIS

The radar video data processors, located at the National Aviation Facilities Experimental Center, and at the Suitland, Maryland, en route surveillance radar site, were tested and evaluated to determine the benefits of contractor-installed modifications. Tests were conducted in controlled radar and beacon environments to enable each modification to be analyzed discretely. Data were collected to evaluate the modified radar processing functions of run length discrimination, dynamic hit width discrimination, and automatic

clutter elimination. Modifications to the beacon sliding window detection and beacon code validation functions were also evaluated. Test results indicated that the modifications improved the performance of the processor by reducing the number of processed targets resulting from radar clutter and excessive radar reply widths. In addition, the probability of correct beacon code validation was enhanced while the probability of erroneously setting special identity and emergency indicators was diminished. Author

N70-41235# Raytheon Co., Wayland, Mass. Equipment Development Lab.

STUDY AND EXPERIMENTATION OF RF PULSE GENERATING AND AMPLIFYING TECHNIQUES FOR IMPROVING RADAR EMISSION CHARACTERISTICS Supplement to Final Report

H. R. Ward, R. F. Guba, and A. C. Parris Jun. 1970 67 p refs Supplement to FAA-RD-69-33

(Contract FA-67-WA-1832)

(FAA-RD-70-41; FAA-RD-69-33-Suppl) Avail: NTIS

A crystal oscillator, broad-band multipliers and an up-converter were used to produce an output in the frequency range 2.7 to 2.9 GHz. Shaped pulses were produced at 30 MHz and linearly mixed with an appropriate S-band signal to give the desired output. A tunable filter was constructed to dispose of unwanted components from the up-converter. The first technique used a 9-pole band-pass Bessel filter through which a 30-MHz pulse was passed to produce the shaped pulse. The second employed a 9-pole low-pass Bessel filter which was used to modulate a gated 30 MHz signal to produce the shaped pulse. Since preliminary tests showed the band-pass technique to be inferior to the low-pass technique, emphasis was concentrated on the latter. Output pulse shape and spectra were measured for various amounts of shaping by varying the gate to the Bessel filter in either technique. The output pulse shape can be varied between a Gaussian-like and a nearly-rectangular pulse. Data were taken for four pulse shapes covering the range of interest. It is concluded that the low-pass technique is capable of duplicating pulse shapes derived during the earlier study, with simplified hardware, having an easily implemented operational capability for trade-off between spectrum purity and radar power efficiency as may be dictated by site requirements. Author

N70-41304# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.

A TECHNIQUE TO IDENTIFY CERTAIN RELATIVE ERRORS IN RADAR X-Y PLOTS

Amos Eddy (Okla. Univ.), Pat Avara, Marvin Kays, and Marty Yerg (Okla. Univ.) May 1970 34 p refs

(AD-709608; ECOM-5301) Avail: NTIS CSCL 17/9

An iterative analysis technique has been developed to identify two of the errors which frequently occur when two radars track the same target and record the information on separate X-Y plotters. Both a relative difference in starting points and a difference in speeds of the plotting arms along the abscissa axis can be identified. Once they are found, the relative errors can be eliminated easily. Application of this technique to computer-simulated data with known errors gave promising results. In each case the errors were identified, and each analysis required three iterations or fewer. The type of sampling used in the data had little effect on the accuracy of the analysis. When the technique was applied to balloon data obtained at White Sands Missile Range, New Mexico, the results were similar to the test data results. Good estimates of the two relative errors between the plots were found, with only two or three iterations required per sounding. Author (TAB)

N70-41331* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ELECTROSTATIC PLASMA MODULATOR FOR SPACE VEHICLE RE-ENTRY COMMUNICATION Patent

Stuart L. Seaton, inventor (to NASA) Issued 3 Jan. 1967 (Filed 29 Apr. 1964) 4 p Cl. 325-65

(NASA-Case-XLA-01400; US-Patent-3,296,531; US-Patent-Appl-SN-363653) Avail: US Patent Office CSCL 17B

A method and apparatus are described for communicating through the layer of ionized gases formed around a space vehicle as it enters or leaves a planetary atmosphere. Negatively charged electrostatic plates repel the free electrons in the plasma layer and divert them from a certain region. An antenna is located such that it can emit electromagnetic waves through the neutral region and provide communication through the ionized layer. R.B.

N70-41333*# Computer Sciences Corp., Falls Church, Va.

CONTINUOUS TRACE MEASUREMENT TECHNIQUE EXPERIMENTAL TEST, PHASE 2 Final Report

A. Vallone Jun. 1970 72 p refs Prepared for Univ. of S. Fla.

(Grant NGR-10-008-011)

(NASA-CR-113872) Avail: NTIS CSCL 17H

Performance and accuracy of the continuous trace geometric model are tested by means of a satellite and station positioning experiment which uses actual observations. The data are right ascension and declination from three passes of Pageos observed with BC-4 cameras. The cameras were located at Beltsville, Maryland; Moses Lake, Washington; and Revilla Gigedo Is., Mexico. The data are preprocessed to eliminate time synchronization and to recover camera orientations and plate continuous traces. Coordinates and relative covariance matrices of the satellite are computed assuming Beltsville and Moses Lake stations to be perfectly located. The position of Revilla Gigedo is evaluated by adjusting its coordinates. The results of the experiment show that the accuracy and practicality of the continuous trace technique is comparable with the accuracy and practicality of other geometrical techniques employing the same data with synchronization. Satellite and station positions are obtained with a precision of a few parts per million which is in agreement with the precision of the measured input data. Author

N70-41360# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.

A METHOD OF DIGITAL FILTERING FOR MOVING TARGET DETECTION BY PULSE RADAR SYSTEMS [EINE METHODE DER DIGITALEN FILTERUNG FUER DIE ENTDECKUNG VON BEWEGTZIELEN BEI IMPULSRADARSYSTEMEN]

Rudolf Ehrmanntraut (Ph.D. Thesis) 1968 123 p refs In GERMAN

Avail: NTIS

A method of digital filtering for the detection of moving targets by a pulse radar system is described. The characteristics of the radar signals, the specifications of the radar equipment, and the modifications to the signal processing circuitry are presented. The results of the research are explained by mathematical models, graphs, and tables. Transl. by P.N.F.

N70-41372* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MEANS FOR COMMUNICATING THROUGH A LAYER OF IONIZED GASES Patent

Stuart L. Seaton, inventor (to NASA) Issued 24 Jan. 1967 (Filed 29 Apr. 1964) 6 p Cl. 325-65

(NASA-Case-XLA-01127; US-Patent-3,300,731; US-Patent-Appl-SN-363654) Avail: US Patent Office CSCL 17B

A method and apparatus for communicating through a layer of ionized gases formed around a space vehicle as it enters or leaves a planetary atmosphere are described. A modulated magnetic field is applied to the layer of plasma such that when electromagnetic waves are directed into the layer of plasma, the reflected electromagnetic waves contain the same modulation as the magnetic field. The device is also useful for measuring the conditions inside a layer of ionized gases. R.B.

N70-41374# California Univ., Santa Barbara. Dept. of Electrical Engineering.
BAND-PASS AND PSEUDO-HIGH-PASS QUASI-OPTICAL FILTERS
D. A. Leedom and G. L. Matthaei [1970] 26 p refs Submitted for publication
(Grant NSF GK-1238)
Avail: Issuing Activity

At millimeter wave frequencies and higher, oversized and focused beam waveguides were used to avoid the high loss and low power handling capability of conventional waveguides at these frequencies. With over sized or focused beam waveguides, most conventional microwave filter circuitry cannot be used without considerable alteration, or cannot be used at all. The structures described are related to conventional microwave structures but are considerably changed in form as needed for quasi-optical applications. Author

N70-41386*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SUPER-HIGH-FREQUENCY (SHF) COMMUNICATIONS SYSTEM PERFORMANCE ON ATS. VOLUME 2: DATA AND ANALYSIS
Aug. 1970 582 p refs Prepared by Westinghouse Elec. Corp. and the ATS Proj. Office
(NASA-TM-X-65341; X-460-70-300) Avail: NTIS HC $10.00/MF $0.65 CSCL 17B

The results of experiments performed at three ground stations utilizing the ATS-1, ATS-3, and ATS-5 are presented. Individual analyses of these experiments are given based on an evaluation of large quantities of data obtained under various controlled and uncontrolled conditions. The conclusions obtained from these data are discussed, and the statistical approach is described. D.L.G.

N70-41404# Academy of Sciences (USSR), Moscow.
DATA TRANSMISSION USING GAUSSIAN CHANNEL WITH NOISELESS FEEDBACK
D. S. Apokorin *In its* Probl. in Data Process., Sect. 5 1969 p 14–15 In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

A time-discrete Gaussian channel with additive noise comprising a sequence of equally distributed and random processes is briefly discussed. Noiseless feedback is assumed, and a message is represented by a certain stationary Gaussian random process independent of the channel noise. Transl. by E.C.

N70-41405# Academy of Sciences (USSR), Moscow.
INTERFERENCE CHARACTERISTICS IN A TELEVISION SYSTEM WITH LINEAR PREDICTION
R. M. Atakhanov *In its* Probl. in Data Process., Sect. 5 1969 p 16–19 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

The interference observation threshold is predicted for a system with additive normal interference or white noise. The interference level in an operational television channel with variable interference is discussed. Transl. by E.C.

N70-41406# Academy of Sciences (USSR), Moscow.
USE OF LINEAR PREDICTION TO ENHANCE NOISE REDUCTION IN TELEVISION SYSTEMS
R. M. Atakhanov, D. S. Lebedev, and L. P. Yaroslavskiy *In its* Probl. in Data Process., Sect. 5 1969 p 20–24 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Examples are described of image transmission using linear coding with channels containing white noise and amplitude and frequency modulated signals. Results of computer simulation and experimental tests using a prototype television set under real time operating conditions are presented. Transl. by E.C.

N70-41407# Academy of Sciences (USSR), Moscow.
EFFECTIVENESS OF ERROR DETECTION USING HAMMING CODE
M. N. Aripov, V. N. Petrova, and Sh. Z. Yunusov *In its* Probl. in Data Process., Sect. 5 1969 p 25–29 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

A statistical analysis was made of error combinations not detected by 9.4 element Hamming code. Statistical error data from telephone circuits were used. The aim is to assess the potential of Hamming code error detection techniques and identify procedures for raising code efficiency. Transl. by E.C.

N70-41408# Academy of Sciences (USSR), Moscow.
UNEQUAL PROBABILITY OF DISTORTION OF CODE COMBINATIONS ON TELEGRAPH LINES
M. N. Aripov and Sh. Z. Yunusov *In its* Probl. in Data Process., Sect. 5 1969 p 30–33 In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Two statistical experimental data series were analyzed. The first series was obtained from test message transmission on a frequency-modulated TT-12/16 two-way telephone/telegraphy system. The equal frequency of each five element code was considered. In the second data series, distortion of separate code combinations was determined by an analysis of received message text. Results show repetition of certain distorted groups. Stationary pulsed interference was identified as one of the causes of group distortion. Transl. by E.C.

N70-41409# Academy of Sciences (USSR), Moscow.
A METHOD FOR SIGNAL DECODING IN A SYSTEM OF RESIDUAL CLASSES
V. D. Bartoshevskiy, V. I. Vasilev, and V. V. Dergilev *In its* Probl. in Data Process., Sect. 5 1969 p 34–39 ref In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

A method is discussed for determining the control fundamentals in non-positioned codes which correct single errors to ensure signal transmission accuracy in a system of residual classes. A circuit diagram is given for a decoding device for the system. Transl. by E.C.

N70-41410# Academy of Sciences (USSR), Moscow.
METHOD FOR EVALUATING INFORMATION RELIABILITY DURING EQUIPMENT OPERATION TAKING DEFECTS AND MALFUNCTIONS INTO ACCOUNT
V. L. Bakhrakh *In its* Probl. in Data Process., Sect. 5 1969 p 40–45 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Methods are described for assessing information reliability in large-scale teleautomatic systems. The reliability of information transmission is considered as well as that of system operational components including equipment for recording, calculating, storage, and logic and arithmetic processing. Three parameters were used to quantitatively measure equipment reliability: (1) probability of information distortion due to malfunctions, (2) average operating time during malfunctions, and (3) the rate of system failures. Transl. by E.C.

N70-41412# Academy of Sciences (USSR), Moscow.
RELIABILITY OPTIMIZATION OF COMMUNICATION CYCLE ELEMENTS
Kh. G. Gulyamov *In its* Probl. in Data Process., Sect. 5 1969

p 52–54 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

The reliability distribution of communication cycle elements is examined. The communication cycle is designated as the quantity of terminal and intermediate commutator equipment and transmission lines between the transmitting station and receiving points. The reliability factor is based on the accurate establishment of a circuit connection. It is assumed that the reliability of a given cycle element is related to its generalized cost. Transl. by E.C.

N70-41418# Academy of Sciences (USSR), Moscow.
OPTIMIZING THE CODING OF MULTIPLEX FACSIMILE TRANSMISSION
V. V. Kolpakov and V. G. Frolushkin *In its* Probl. in Data Process., Sect. 5 1969 p 86–91 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

The problem of selecting an algorithm for minimizing signal losses due to channel noise is considered. The root-mean-square difference between the received and transmitted document is taken as the loss criterion on the basis of an algorithm for comparing the source signal with that subjected to losses in the transmission channel. The various types of modulation used in transmitting the digital signals are discussed. Transl. by R.B.

N70-41419# Academy of Sciences (USSR), Moscow.
THE PROBLEM OF THE MATHEMATICAL MODEL AND CHANNEL CAPACITY IN ASYNCHRONOUS MULTIPLEXING OF BINARY SIGNALS
M. N. Koltunov and G. V. Konovalov *In its* Probl. in Data Process., Sect. 5 1969 p 92–100 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

A binary-digital channel is considered which comprises a system with asychronous multiplexing of binary signals from a number of independent transmitters, but with which the corresponding receivers are synchronized with an accuracy determined by the cophasal ratio. The principle of investigating the channel is discussed, using a mathematical model of the binary channel, the conversion probabilities in which are assigned by considering the detection of binary characters in the receiver at different values of the cophasal ratio. A general expression is derived for the data transmission rate and the channel capacity is determined. Transl. by R.B.

N70-41430# Academy of Sciences (USSR), Moscow.
METHODS OF PREDISTORTION IN TRANSMISSION OF IMAGES
I. I. Tsukkerman *In its* Probl. in Data Process., Sect. 5 1969 p 161–166 In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Various method of predistorting images in television transmission are reviewed. The limitations arising during corresponding operations on the video signal are pointed out. The advantages of predistortion before scanning, using electro-optical systems, are indicated. Transl. by R.B.

N70-41527# Federal Aviation Administration, Washington, D.C.
SATELLITE COMMUNICATIONS, NAVIGATION AND SURVEILLANCE
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 1–13 (See N70-41526 23-02)
Avail: NTIS

Aeronautical services via satellites are discussed as to ways in which the feasibility, method, and cost of providing such services affect short and long term objectives, to what extent the FAA should pursue this area and what relative priority should be assigned, the operational need, and the cost/benefit factors. Development of both VHF and L-band technology is considered, along with the possibilities of a hybrid configuration. The proposed development program for the aeronautical satellite system and the near term requirement plan are included. P.A.B.

N70-41566# Rome Air Development Center, Griffiss AFB, N.Y. Advanced Sensor System Section.
RANDOM LINEAR TIME-VARIANT CHANNELS. A SURVEY OF CHARACTERIZATION, PHYSICAL EXAMPLES, SIMULATION AND MEASUREMENT TECHNIQUES
John A. Ritz (M.S. Thesis—Syracuse Univ., N.Y.) Jun. 1970 254 p refs
(AD-709680; RADC-TR-70-116) Avail: NTIS CSCL 9/4

A survey of the engineering literature associated with random time-variant channels is presented. It is demonstrated that linear time-variant channels may be characterized in a symmetrical manner in terms of time and frequency variables by arranging system functions in (time-frequency) dual pairs. The correlation functions and power spectral densities of these various system functions give a statistical characterization of the channel. All real-life channels and signals have a finite number of degrees of freedom due to restrictions on time duration and bandwidth. This fact is used to derive useful channel models with the aid of sampling theorems and power series expansions. A large number of physical channels exhibit time-variant behavior. Examples of the many physical time-variant channels are discussed and theoretical and experimental results of multipath and Doppler spread are given. Author (TAB)

N70-41574# Congress. House. Committee on Foreign Affairs.
FOREIGN POLICY IMPLICATIONS OF SATELLITE COMMUNICATIONS
Washington GPO 1970 116 p refs Hearings before Comm. on Foreign Affairs, 91st Congr., 2d Sess., 23, 28, and 30 Apr. 1970
Avail: Subcomm. on Natl. Security Policy and Sci. Develop.

Congressional testimony is reported on the foreign policy aspects of satellite broadcasting and on a study of developmental television in Latin America. The status of international agreements on satellite communications is discussed. R.B.

N70-41585# California Univ., Berkeley. Electronics Research Lab.
SCATTERING OF MICROWAVE RADIATION FROM A TURBULENT WATER SURFACE
D. E. Tremain and D. J. Angelakos 1 Jul. 1970 62 p refs
(Contract N00014-69-A-0200-1035)
(AD-709453; ERL-70-3) Avail: NTIS CSCL 20/1

An experiment has been constructed to investigate the feasibility of detecting low frequency underwater sound sources under turbulent surface conditions by illuminating a small portion of the water surface with an unmodulated beam of 8mm microwave radiation. The unmodulated beam became phase modulated upon reflection from the water surface. This phase modulation was detected by a synchronous phase detector and was processed using digital autocorrelation and Fast Fourier Transform techniques to yield the spectral components present in the water surface. The angular positions of the transmitting and receiving antennas with respect to the surface normal were adjustable independently over wide ranges in this experiment. Results have been obtained for the case of specular reflection in which the angles of incidence and reflection each varied from 5 degrees to 50 degrees, with respect to the surface normal. These results indicate that a submerged source vibrating with a large amplitude at a frequency above the surface roughness spectrum may be detected readily for angles of incidence and reflection up to about 35 degrees from the normal. The source may be detected for angles of incidence and reflection between 40 degrees and 50 degrees only if two or three transforms

are averaged; detection is more difficult for angles in this range. A number of cases of backscattering have been investigated as well, but the source could not be detected in any of these cases because the detection system was not sufficiently sensitive. Author (TAB)

N70-41608# Naval Research Lab., Washington, D.C.
TIME AND FREQUENCY TRANSFER VIA MICROWAVE LINK Interim Report
D. H. Phillips, R. E. Phillips, and J. J. O'Neill 26 Jun. 1970 18 p
(AD-709443; NRL-7140) Avail: NTIS CSCL 17/2

A two-way microwave link between the Naval Research Laboratory and the Navy Observatory has been established to transfer both time and frequency information with high accuracy. Time and frequency information is transmitted simultaneously by algebraically adding together a precision 1 MHz signal and 1 pps, thus providing continuous phase information for frequency comparison and epoch time by the pulse. Phase resolution is better than 10 nanoseconds and determination of epoch time better than 0.1 microseconds. Seven precision standards have been intercompared via the microwave link. Continuous phase recording since September 1969 has shown no diurnal dependence and very little effect due to seasonal and temperature changes. A second microwave link has been established between The Naval Observatory and the Naval Research Laboratorys satellite research communications terminal in Waldorf, Maryland. Author (TAB)

N70-41616# General Instrument Corp., Hicksville, N.Y. Electronic Systems Div.
RADAR SET AN/PPS-17 (FAILURE FREE DEVELOPMENT PROGRAM) Interim Development Report, 1 May–31 May 1970
Walter Seidman and Al Zecca 30 May 1970 74 p
(Contract N00039-70-C-3501)
(AD-709469; ESD-1158-IR-4) Avail: NTIS CSCL 17/9

The report covers the Phase II portion of the program to design, manufacture and test 20 high reliability radar; AN/PPS-17. The report covers the period during which breadboard system integration is continuing and evaluation, testing of the Klystron and solid state transmitter is being conducted. Author (TAB)

N70-41640# Congress. House. Committee on Interstate and Foreign Commerce.
SEVENTH ANNUAL REPORT ON ACTIVITIES AND ACCOMPLISHMENTS UNDER THE COMMUNICATIONS SATELLITE ACT OF 1962 Message from the President of the United States
Washington GPO 1970 17 p Presented to Comm. on Interstate and Foreign Com., 91st Congr., 2d Sess., 26 Feb. 1970
(H-Doc-91-264) Avail: US Capitol, House Document Room

Federal coordination, planning, and support of the Global Commercial Communications Satellite System are reported to Congress. The Intelsat satellites launched in 1969 are summarized and accomplishments are evaluated. The conceptual framework of the global system is outlined including space development, operational satellites, advanced satellites, and satellite tracking, telemetry, command, and monitoring. Earth stations and NASA's use of the system are mentioned. A progress chart, table of growth in operational capability, and global map of operational earth stations are appended. J.M.

N70-41672# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WIRELESS TRANSMISSION LINES (EXCERPTS)
A. M. Pokras 6 Jan. 1970 46 p refs Transl. into ENGLISH from the Russian
(AD-702829; FTD-HT-23-4-70) Avail: NTIS CSCL 17/2

Discussed are various passive relay arrangements and calculations of attenuation on passive relay equipped runs, planning systems with passive relays; and a method of measuring the characteristics of passive relays. TAB

N70-41678* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METHOD AND APPARATUS FOR DETERMINING ELECTROMAGNETIC CHARACTERISTICS OF LARGE SURFACE AREA PASSIVE REFLECTORS Patent
Abe Kampinsky, inventor (to NASA) Issued 29 Nov. 1966 (Filed 17 May 1965) 9 p Cl. 343-18
(NASA-Case-XGS-02608; US-Patent-3,289,205;
US-Patent-Appl-SN-456578) Avail: US Patent Office CSCL 17B

An apparatus for measuring the radio frequency backscatter and transmission characteristics of a sample segment of a large spherical reflector formed from an inflatable membrane, such as the Echo satellites, is described. A continuous wave or pulse radar unit illuminates the center portion of the sample membrane. Both monostatic and bistatic backscatter may be determined by using separate, independently moveable transmitting and receiving antennas. The radar may be circularly or linearly polarized to measure the characteristics of membranes containing open mesh or grid-like structures. N.E.N.

N70-41680* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHASE-LOCKED LOOP WITH SIDEBAND REJECTING PROPERTIES Patent
Donald W. Brown, Mahlon Easterling, Warren L. Martin, and Edward C. Posner, inventors (to NASA) Issued 22 Nov. 1966 (Filed 1 Jun. 1964) 10 p Cl. 343-14 Sponsored by NASA
(NASA-Case-XNP-02723; US-Patent-3,287,725;
US-Patent-Appl-SN-371857) Avail: US Patent Office CSCL 17I

In a continuous wave tracking radar system using the same antenna for transmitting and receiving, the received interrupted continuous wave signal is detected and then multiplied by the keying waveform, delayed 90 deg. The integral of the resulting signal over a period of time is substantially zero if the received signal is the carrier and is other than zero if it is a sideband. This distinguishing feature is used for breaking the lock on the sideband signal, so that the receiver is enabled to lock to the carrier signal instead. P.A.B.

N70-41707# Air Force Cambridge Research Labs., Bedford, Mass.
A THEOREM ON CONVERGENCE OF ENTROPY FOR SMALL DISTORTION
John N. Pierce May 1970 24 p refs *Its* Ser. No. AFCRL-PSRP-418
(AD-709357; AFCRL-70-0274) Avail: NTIS CSCL 9/4

Let X be a random variable with an absolutely continuous distribution function, and (Uk) be a sequence of random variables, independent of X, whose r-th mean converges to zero. Then it is shown that the existence of the R-th mean of X, for some positive R, is sufficient to guarantee the convergence of the entropy of X+(U sub k) to that of X. This theorem is useful in determining asymptotic approximations to the rate-distortion function and is thus pertinent to the problem of establishing the bit rate necessary to communicate at a specified small distortion. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N70-40438# Texas A&M Univ., College Station. Inst. of Statistics.
CONVEX: A COMPUTER PROGRAM FOR SOLVING CONVEX PROGRAMS
H. O. Hartley, R. R. Hocking, L. R. La Motte, and H. H. Oxspring Jul. 1970 26 p refs
(Contract N00014-68-A-0140)
(AD-708580; THEMIS-TR-23) Avail: NTIS CSCL 9/2

The report describes a computer program implementing the Hartley-Hocking convex programming algorithm. The two parts of this report are, respectively, a description of the Hartley-Hocking method as extracted from the original paper, and the documentation of the computer program. Author (TAB)

N70-40458 Polytechnic Inst. of Brooklyn, N.Y.
CANONICAL OBSERVERS IN LINEAR CONTROL SYSTEMS
Muhammadi Siswosudarmo (Ph.D. Thesis) 1969 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-17801

The use of a compatible observer in feedback control system is investigated. It is shown that the closed loop eigenvalues are the eigenvalues of the observer and the eigenvalues of the closed loop system with an error free compatible observer. When a compatible observer is used in a regulator control system which for error free observer is optimal with respect to a quadratic cost index, for a finite time interval, an increase of cost index is expected. It is shown that for a subclass of initial states, the increase of cost becomes larger when the real parts of the eigenvalues of A become more negative. The eigenvalues of A can be selected so as to minimize an upper bound of the increase of cost for all admissible initial states. It is also established that there exists no feedback law better than the optimal regulator, which gives a minimum cost index for all initial states when the overall system is required to be stable. Dissert. Abstr.

N70-40509 Utah Univ., Salt Lake City.
GEOMETRIC MODELING
Charles Stephen Carr (Ph.D. Thesis) 1969 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-18999

A system is presented for modeling three-dimensional objects, such as buildings and mechanical devices, in the computer. The system was implemented as an interactive design system. Shaded, half-tone photographs of objects designed with the system are included. An algorithm is presented for quickly determining if two objects, created by the human user, interpenetrate one another. The user is informed of such violations by the system. Additionally, basic concepts of computer graphics modeling are presented. The implementation of these ideas as an interactive design system for architects on the Univac 1108 computer is described. The implementation used the most modern programming techniques, such as a compiler/compiler to generate a graphics programming language processor, and a hashed associative data base. Dissert. Abstr.

N70-40524 California Univ., Los Angeles.
ITERATIVE COMPUTING TECHNIQUES FOR THE SOLUTION OF LARGE SCALE EQUATION SYSTEMS
Wei Lai Chen (Ph.D. Thesis) 1969 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-17555

In the solution process, the large scale system is first partitioned into a number of smaller and more easily manageable sections. The partial solutions obtained from the sections are connected together to yield the overall solution by means of iterative computations. In the hybrid approach, the repetitive computations can be carried out in a parallel mode by the analog equipment, such that the per iterative cycle time can be substantially reduced. The convergence criteria for the hybrid iterative schemes were established, and the computational methodologies were also defined. The positive definite property is fundamental to the development of the iterative discrete-space/discrete-time (DSDT) approach for solving partial differential equations by means of electrical networks. Dissert. Abstr.

N70-40547 California Univ., Berkeley.
ANALYSIS AND SYNTHESIS OF TWO-DIMENSIONAL PATTERNS USING PICTURE-PROCESSING GRAMMARS
Shi-kuo Chang (Ph.D. Thesis) 1969 213 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-18893

A formal picture-processing grammar is defined to serve as a model for the analysis and synthesis of two-dimensional pictures. A universal picture analyzer is constructed. It can accept picture-processing grammar in tabular form and then process pictures using that grammar. Experiments have been performed to analyze hand-written numerals, Chinese ideograms, and two-dimensional mathematical formulas. A picture generation program which can synthesize a picture belonging to a given category is also written. Two methods to construct picture-processing grammars are presented. The first method is applicable if the pictures are relatively simple. It is able to construct a grammar describing exactly a given set of pictures. The second method is a heuristic method to construct a grammar modelling the preprocessing stage of a pattern recognition system. Extension to probabilistic grammar and addition of semantic rules to the grammar are discussed. Dissert. Abstr.

N70-40551# Picatinny Arsenal, Dover, N.J. Data Processing Systems Office.
CIMPLE: CARD IMAGE MANIPULATOR FOR LARGE ENTITIES
Edward A. Radek Mar. 1970 79 p
(AD-708562; PA-TM-1927) Avail: NTIS CSCL 9/2

CIMPLE (Card Image Manipulator for Large Entities) was written to facilitate the orderly modification and testing of large FORTRAN programs. The 80 character card images for source, object, or data decks are stored in 90 character fields on tape. A sequence number and a special symbol for each card image is stored in the last 10 characters of this 90 character field. The special symbols are used to distinguish original card images from those which have been added or deleted. In the case of FORTRAN source statements, an original card image is made a 'comment card' if an attempt is made to delete it. TAB

N70-40559# Stanford Research Inst., Menlo Park, Calif.
HIGH-INFORMATION-DENSITY STORAGE SURFACES Final Report, 1 Apr. 1965 – 31 Jan. 1970
L. N. Heynick Jun. 1970 104 p
(Contract DA-28-043-AMC-01261(E))
(AD-708578; ECOM-01261-F) Avail: CFSTI CSCL 9/2

The program was devoted to the development of novel electron-beam-addressable data-storage mosaics and of the requisite high-resolution electron-optical systems and accessories for performing storage and readout at high speeds, with a view toward demonstrating experimentally that advanced memory systems of this kind are practical. The mosaics developed consist of substrate-supported metal/dielectric/metal film sandwiches about 1-micrometer thick having regular arrays of submicron-diameter holes on approximately one micrometer centers; the storage elements are microcapacitors, called micro-caps, at the bases of the holes. With dc across the sandwich, an electron beam is used to set each micro-cap to the potential of either film, with these micro-cap potentials constituting the binary states. In readout, the energy difference of the secondary electrons emerging from the element holes is used to distinguish between the states. The electron-optical system developed for data storage and readout consists essentially

of a field-emitter source, an apertured three-element electrostatic lens, an octupole deflector of very low aberration constants, and a velocity-selector/electron-multiplier combination for binary-state discrimination and amplification. Author (TAB)

N70-40564# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
DESIGN OF A DATA ACQUISITION SYSTEM IN THE FLUID MECHANICS LABORATORY OF THE UNIVERSITY OF WATERLOO
E. Lennemann and J. H. G. Harold. May 1970. 41 p. Sponsored in part by Natl. Res. Council of Can.
(Grant DRB-G-9550-19)
(TN-12) Avail: NTIS

The improvement of fluid mechanics experiments by efficient and accurate data acquisition is discussed. The data acquisition provides a basis for the subsequent data reduction process which was designed in such a way that it led to the development of a digital or analog computer subroutine library for standard fluid mechanics experiments. Author

N70-40578# Stanford Univ., Calif. Dept. of Computer Science.
FORMALIZATION OF PROPERTIES OF PARALLEL PROGRAMS
Edward Ashcroft and Zohar Manna. Feb. 1970. 60 p. refs
(Contract ARPA SD-183; ARPA Order-457)
(AD-708740; SU-AIM-110) Avail: NTIS CSCL 9/2

The paper describes a class of parallel programs and gives a formalization of certain properties of such programs in predicate calculus. Although the programs are syntactically simple, they do exhibit interaction between asynchronous parallel processes, which is the essential feature to be considered. The formalization can easily be extended to more complicated programs. Also presented is a method of simplifying parallel programs, i.e., constructing simpler equivalent programs, based on the independence of statements in them. With these simplifications the formalization gives a practical method for proving properties of such programs. Author (TAB)

N70-40588# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATING THE EFFICIENCY OF A CYLINDRICAL MAGNETIC-FILM ELEMENT FOR USE IN AN ASSOCIATIVE MEMORY
Ya. Pikhlau. 20 Apr. 1970. 12 p. ref. Transl. into ENGLISH from Izv. Akad. Nauk Eston. SSR, Ser. Fiz.-Mat. (Tallinn), v. 17, no. 3, 1968 p. 330–334
(AD-708442; FTD-MT-24-46-70) Avail: NTIS CSCL 9/2

Results of a study of the drive-current tolerances of a plated-wire magnetic-film element for an associative memory are presented. The operating region is calculated theoretically using a method developed by O. V. Rosnitskiy. A linear approximation is used for the boundary between the regions of drift and stable recording, and the effect of adjacent elements and control wires is ignored. The operating region is represented as a set of solutions of a system of linear inequalities. Experiments are performed with elements made by depositing Permalloy film 1-1.5 mu thick on wire 0.2 mm in diameter of BrB2 beryllium bronze. The five-turn coils were of PEV-2 wire 0.07 mm in diameter. The experimentally determined stability region makes it possible to ascertain the rated drive currents and their tolerances. Author (TAB)

N70-40623 University of Southern Calif., Los Angeles.
SUBOPTIMAL ADAPTIVE SAMPLED-DATA REGULATOR SYSTEM DESIGN USING STOCHASTIC APPROXIMATION
Douglas Floyd Elliott (Ph.D. Thesis). 1969. 193 p.
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00. Order No. 69-17878

It is shown under rather weak conditions that a transformation consisting of a rotation and rescaling of the parameter space coordinate system leads to convergence of a stochastic approximation sequence to a unique minimum in a subset of parameter space. The transformation is determined from the regression function's matrix of second partial derivatives, if this matrix exists. Although the regression function is not generally known, the coordinate transformation may actually be determined numerically using an algorithm which results from one of the theorems. Convergence rates with and without the transformation of parameter space coordinates are compared. It is shown that under fairly general conditions that at any iteration the norm of the average error and the mean square error in the parameter vector setting are reduced more using the transformation of coordinates with a probability arbitrarily close to one. Dissert. Abstr.

N70-40630# California Univ., Los Angeles. School of Engineering and Applied Science.
CASE STUDIES IN COMPUTER SIMULATION. SYSTEMS ANALYSIS OF THE MANAGEMENT INFORMATION SYSTEM/COMPUTER SYSTEM, LONG BEACH NAVAL SHIPYARD
A. M. Feiler. Mar. 1970. 33 p. ref
(Contract N00014-69-A-0200-4009)
(AD-708769; UCLA-ENG-7049) Avail: NTIS CSCL 13/10

The report describes application of the general-purpose computer simulator, TRANSIM IV, to systems analysis of the Long Beach Naval Shipyard computer systems operating under the shipyards Management Information System workload. The MIS/Computer System Model is described and results are given for a representative simulation analysis to serve as a demonstration example for further problem-solving applications with the model by the LBNSY staff. Author (TAB)

N70-40640 Polytechnic Inst. of Brooklyn, N.Y.
COMPUTER CONGESTION ANALYSIS: A THEORETICAL TREATMENT
Wei Chang (Ph.D. Thesis). 1969. 115 p.
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00. Order No. 69-17782

A priority queuing model was developed to analyze the response time of a message in a simple real-time computer system. Each message consists of two tasks: the communication task which is placed in the high priority queue, and a processing task which is executed by the computer on an available basis. The stationary queue length and the waiting time distributions are investigated. Numerical results are presented. A single-server priority queuing system which processes two kinds of inputs: regular (constant interarrival time) and random is presented. The time-dependent solution is provided. The solution is given in the form of the virtual waiting-time distribution. Finally, a queue-dependent situation is investigated. Two service time distributions, H(x) and Q(x), are assumed for a single server system. Just before a customer is served, the queue size is examined. Dissert. Abstr.

N70-40665# California Univ., Los Angeles. School of Engineering and Applied Science.
MEASUREMENT OF RECURSIVE PROGRAMS
V. G. Cerf. May 1970. 113 p. refs
(Contract ARPA SD-184; AT(11-1)-10)
(AD-708770; UCLA-70-43; UCLA-10P14-90) Avail: NTIS CSCL 9/2

The report surveys program measurement techniques and concentrates attention on the automatic generation of in-line instrumentation. Measures of program efficiency are developed for recursive syntax analyzers written in the META-5 language. The implementation of measurements necessary to evaluate programs

according to the theoretical measures is described. Consideration is given to application of the measurements to the optimization of alternative ordering within syntax rules. Author (TAB)

N70-40732 National Lending Library for Science and Technology, Boston Spa (England).
IBM 1800 FOR THE CERN PROTON SYNCHROTRON: SPECIFICATIONS AND CONFIGURATION
H. Van Der Beken 8 Jun. 1970 6 p Transl. into ENGLISH of CERN MPS/INT-CO-66-10
(NLL-LB/9/2741-(9091.9F); MPS/INT-CO-66-10) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A component characteristics summary is presented for the IBM 1800 processor including digital input and interrupts, analog input, digital and analog output, control signals, and peripherals. A system configuration flow chart is appended. J.M.

N70-40788# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
CONTROL STRUCTURES FOR PROGRAMMING LANGUAGES
David A. Fisher (Ph.D. Thesis) May 1970 217 p refs
(Contract F44620-67-C-0058)
(AD-708511; AFOSR-70-1846TR) Avail: NTIS CSCL 9/2

The dissertation attempts to demonstrate that complexity diminishes and clarity increases to a marked degree if algorithms are described in a language in which appropriate control structures are primitive or easily expressible. The thesis catalogs a number of control structures and uses them to develop an extensible language. The features of the language (primitive control operations for sequential processing, parallel processing, alternative selection, monitoring, synchronization, and relative continuity) are the source of the clarity of control descriptions: they span our conceptual notion of control, and they can be easily decomposed to form other more specialized control structures. Author (TAB)

N70-40797# Naval Postgraduate School, Monterey, Calif.
APPLICATION OF DISPLAY IN FLIGHT VEHICLE MISSION PERFORMANCE EVALUATION
Willi Konrad Alois Krauss (M.S. Thesis) Oct. 1969 82 p refs
(AD-709057) Avail: NTIS CSCL 9/3

With the increase in speed of moving vehicles there is a growing need for rapid, easy to interpret display of information concerning its dynamic state. With growing equipment stability a remedy can grow out of research and application of computer aided information presentation, especially the production of proper displays. While all information can be made to correspond to familiar schemes as close as desired new approaches to the general problem must be sought to find an improved information presentation. This study is concerned with the application of computer generated graphics for one or more display consoles for aid in the operation of the vehicle. In the first chapter a major aspect of the general program is chosen for a demonstration: a flight vehicle to destination situation is subjected to an experimental investigation. A general purpose computer with a graphics terminal that has become available just recently has been chosen for the study. Thereby implicitly a measure of the capability to perform a real time on line job is obtained. Author (TAB)

N70-40803# Stanford Research Inst., Menlo Park, Calif.
CELLULAR LOGIC-IN-MEMORY ARRAYS, PART 1 Final Report, 1 May 1965–30 Apr. 1970
William H. Kautz, Marshall C. Pease, III, and Milton W. Green May 1970 178 p refs
(Contract Nonr-4833(00))
(AD-708450) Avail: NTIS CSCL 9/2

The report presents the results of a five-year research project, the objective of which has been to develop both general and specific design techniques for the realization of memory systems containing built-in logic, and to evolve a theoretical and practical understanding of the nature and capabilities of such logic-in-memory arrays. The document deals only with material that has not already been reported in the technical literature (these items are listed in the appendix). Described herein are special-purpose, cellular logic-in-memory arrays for sorting, matrix inversion, arithmetic, and binary correlation, as well as some parallel computation algorithms that readily lend themselves to cellular implementations for multivariate interpolation, matrix inversion, the solution of linear equations, and linear programming problems. So-called programmable cellular arrays for the realization of arbitrary combinatioal and sequential logic are also described. Finally, general design principles for cellular logic-in-memory arrays are widely applicable to digital-information-processing systems at several different levels. Because of their inherent flexibility in function and behavior, their amenability to realization by the most promising fabrication technology known, and their other desirable features, they can be expected to find wide application in the future in almost all types of digital hardware. A second part of this report will cover some very recent work on the design and utilization of an array processor, and will be issued separately later in 1970. Author (TAB)

N70-40897# Utah Univ., Salt Lake City.
GRAPHICAL MAN/MACHINE COMMUNICATIONS Semiannual Technical Report, 1 Jun.–30 Nov. 1969
David C. Evans 30 Nov. 1969 24 p refs
(Contract AF 30(602)-4277; ARPA Order 829)
(AD-708483; SA-TR-6; RADC-TR-70-85) Avail: NTIS CSCL 9/2

The document includes a summary of research activities and facilities at the University of Utah. Report abstracts convey important research milestones attained during this period by each of the four major research activities computer graphics techniques, computing systems, digital waveform processing, applications. Author (TAB)

N70-40943# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
INTERFACE MESSAGE PROCESSORS FOR THE ARPA COMPUTER NETWORK Quarterly Technical Report, 1 Apr.–30 Jun. 1970
Frank E. Heart Jul. 1970 17 p
(Contract DAHC15-69-C-0179; ARPA Order 1260)
(AD-709621; BBN-2003; QTR-6) Avail: NTIS CSCL 9/2

The report describes several aspects of progress on the ARPA Computer Network during the second quarter of 1970. During this period, IMPs Nos. 6, 7, 8, and 9 were installed at MIT, Rand, SDC, and Harvard, respectively. AT+T has not yet provided circuits to Harvard, but the eight-node subnet is operational. The temporary circuit connecting BBN and UCLA was taken down and replaced by a circuit between BBN and Rand. A circuit that is listed as temporary was installed between MIT and Utah. TAB

N70-40954*# General Dynamics/Convair, San Diego, Calif.
SOFTWARE INTEGRATION FOR INTEGRATED ELECTRONICS
R. F. Klawa *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 51–66 (See N70-40951 23-31)
Avail: NTIS CSCL 09B

An approach is discussed for minimizing cost and schedule problems of software integration of the avionics system. The decisions affecting software are the degrees of centralization, autonomy, crew participation versus automation, redundancy, and commonality, which are targeted at low cost integrated avionics. The objectives of the various development phases are discussed. R.B.

N70-40956*# International Business Machines Corp., Huntsville, Ala.
ON BOARD DATA MANAGEMENT
R. E. Poupard *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 85-90 (See N70-40951 23-31)
Avail: NTIS CSCL 09B

The various elements and functions of the onboard data processing system for the space shuttle are outlined. The problems associated with checkout, fault isolation, redundancy management, software, and displays and controls are discussed briefly. R.B.

N70-40971*# General Electric Co., Daytona Beach, Fla.
COMPUTER GENERATED IMAGERY AS APPLIED TO SPACE SHUTTLE DESIGN EVALUATION AND SYSTEM SIMULATION
M. Marvin Bunker *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 313-322 (See N70-40951 23-31)
Avail: NTIS CSCL 09B

Visual scene simulation for showing solid objects in true perspective and in color is considered. The objects comprising a scene are formed of faces with specified color, which are, in turn, formed by straight line segments referred to as edges. The objects are modeled by specifying the three-dimensional coordinates of the vertices of the edges. Application of the system to space shuttle vehicles is discussed as a function of window area and landing attitude, as well as a function of window area and vehicle configuration. R.B.

N70-41009# California Univ., Los Angeles. School of Engineering and Applied Science.
SYNTAX DIRECTED TRANSLATION OF CONTEXT FREE LANGUAGES
S. A. Vere Apr. 1970 113 p refs
(Contract N00014-69-A-0200-4027)
(AD-709137; UCLA-70-39) Avail: NTIS CSCL 9/2

The report presents a new general class of syntax directed translations defined on a context free grammar. The class is called VGSDT. For each nonterminal symbol X in the grammar, one or more translations of X are defined. These translations are in general defined in terms of the translations of (1) the direct descendants of X and (2) the direct ancestor of X. As a result, translations of a given node in a parse tree can be a function of any part of the parse tree, both above and below the node. An intra-language grammatical transformation is a grammatical transformation which preserves the language generated by the original grammar. Suppose a translation is defined on a grammar G1, and G1 is then modified according to an intra-language grammatical transformation to give another grammar G2. It is shown that a translation defined on G1 using VGSDT can always be converted to one defined on G2. If the original translation is defined using one of the less general translation schemes, this is not always true. Consequently, while translations in the VGSDT class are actually defined on a specific context-free grammar, it would be more accurate to say that they are defined on the language itself, since the particular form of the underlying grammar is arbitrary. Author (TAB)

N70-41022# Naval Postgraduate School, Monterey, Calif.
AN INTERACTIVE MATRIX INTERPRETIVE SYSTEM FOR THE IBM 360/67
Robert Douglas Little (M.S. Thesis) Jun. 1970 97 p refs
(AD-709094) Avail: NTIS CSCL 9/2

The Matrix Interpretive System devised by Wilson and modified by Cantin has been transformed into an interactive program operable under a time sharing system. Several new commands have been added to extend the usefulness of the code and give it the capability to offline read, write and punch data, to plot graphs and contour maps and to integrate simple polynomial expressions. Author (TAB)

N70-41154# Stanford Research Inst., Menlo Park, Calif.
COMPUTER AUGMENTED MANAGEMENT SYSTEM RESEARCH AND DEVELOPMENT OF AUGMENTATION FACILITY Final Technical Report, 8 Feb. 1968 - 8 Feb. 1970
D. C. Engelbart Apr. 1970 348 p refs
(Contract F30602-68-C-0286)
(AD-709211; RADC-TR-70-82) Avail: NTIS CSCL 9/2

The report covers two years of research in a continuing program in the Augmentation Research Center (ARC) of the Information Sciences Laboratory of Stanford Research Institute. The research reported is aimed at the development of on-line computer aids for increasing the performance of individuals and teams engaged in intellectual work, and the development of techniques for the use of such aids. The report covers hardware and software development; applications in several areas relating to management of a community of workers who use on-line aids and to information management for such a community, participation in the ARPA computer network, and a summary of plans for the continuation of the research. Author (TAB)

N70-41192*# Maryland Univ., College Park. Computer Science Center.
CDL DESCRIPTION OF A MEMORY BUFFER ORGANIZATION
Yaohan Chu Aug. 1970 28 p refs
(Grant NGR-21-002-206)
(NASA-CR-113908; TR-70-126) Avail: NTIS CSCL 09B

In recent years, an important development in the organization of computer memories has been the use of a storage hierarchy on the nanosecond/microsecond level and more specifically of a very high-speed semiconductor memory as a buffer to the main memory of the computer system. A memory-buffer organization and its operation are described similar to that implemented in the IBM System/360 model 85. The computer design language is employed to describe the details of the functional organization and of the sequential operation of the buffer in a concise and precise manner. Author

N70-41238*# Intermetrics, Inc., Cambridge, Mass.
MULTIPROCESSOR COMPUTER SYSTEM STUDY Final Report, 27 Jun. 1969 - 27 Mar. 1970
James S. Miller, Daniel J. Lickly, Alex L. Kosmala, and Joseph A. Saponaro Mar. 1970 165 p refs
(Contract NAS9-9763)
(NASA-CR-108654) Avail: NTIS CSCL 09B

The results of a study of multiprocessor computer systems, related theory, and potential problems associated with implementation of such a system in a space station data management system are presented. The background and terminology involved are reviewed, and the relevant results of a survey of existing multiprocessor flight and ground-based systems are given. Design considerations which are relevant to the architectural configuration of the data management computer system are described. The major design guideline constraints and requirements applicable to the system are discussed. The architectural design of a multiprocessor computer system capable of satisfying the requirements is presented. Author

N70-41249# Texas Univ., Austin. Information Sciences Research Lab.
OPTIMUM TECHNIQUES FOR LINEAR FEATURE EXTRACTION
T. L. Henderson and D. G. Lainiotis 1 Dec. 1969 145 p refs
(Grants AF-AFOSR-1792-69; AF-AFOSR-1764-69)
(AD-708510; TR-73; AFOSR-69-2759TR) Avail: NTIS CSCL 9/4

Methods are developed for processing a set of measurements to extract their most important features. The problem is approached from the viewpoint of pattern recognition, assuming two pattern classes, with particular emphasis given to the signal-in-noise detection problem. It is supposed that the feature extractor transforms the measurements into a finite-dimensional feature space, of smaller dimension than the measurement space. Author (TAB)

N70-41282# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.
LEARNING CONTROL SYSTEMS AND PATTERN RECOGNITION Annual Progress Report, 15 Sep. 1968 - 15 Sep. 1969
J. W. Moore, E. S. McVey, R. L. Ramey, E. J. White, and E. A. Parrish Nov. 1969 207 p refs
(Contract DAAB07-68-C-0066)
(AD-709639; THEMIS-3375-1; APR-1) Avail: NTIS CSCL 9/4

The report covers progress in the second year on a Project THEMIS contract for research in Learning Control Systems and Pattern Recognition. Topics covered include academic progress, system stability studies, digital predictive compensation, resolution improvement in pattern recognition systems, general purpose pattern classifiers and data acquisition, photo optic receptor systems, and thin film diode research. Section I covers academic progress, new courses developed as a result of the research program, graduate degrees obtained and publications in the technical literature of research results. Section II covers the determination of the degree of controllability which must be required of the system and digital predictive compensation system. Section II reports on the progress in pattern recognition, generally efforts to improve resolution, development of a system to collect and analyze pattern data, and development of a modular approach to a general purpose pattern classifier. Section IV reports progress in the development of photo sensitive receptor system. Research has been done on the use of fiber optic methods for converting from photo information to electronic information. Research continues on the development of thin film diode arrays. These offer promise of receptors of very high density, perhaps approaching a million individual elements per square inch. Section V relates the research to ultimate military goals and gives a general summary of the work. Author (TAB)

N70-41292# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
EXPANDING THE RANGE OF APPLICATION OF THE PROGRAMMING LANGUAGE EXAPT 1 [UNTERSUCHUNGEN ZUR ERWEITERUNG DES EINSATZBEREICHES DER PROGRAMMIERSPRACHE EXAPT 1]
Hartmut Fetzer (Ph.D. Thesis) 25 Sep. 1968 191 p refs In GERMAN
Avail: NTIS

Various methods and techniques are proposed to increase the flexibility of EXAPT 1 to the maximum extent possible. Among the techniques are considerations for programming conversion codes for different data processing units, proposals for programming milling machines, and proposals for simplification of post-processor programming. The data obtained permit rational use of existing transmission components under development, so that the limitations of EXAPT 1 may be important in selecting a model case. Transl. by R.B.

N70-41298*# Teledyne Brown Engineering, Huntsville, Ala.
AMTRAN SYSTEM DESIGN AND SOFTWARE DESCRIPTION
M. E. Dyer May 1970 282 p
(Contract NAS8-20415)
(NASA-CR-102834; IESD-COMP-1171) Avail: NTIS CSCL 09B

A detailed description is presented of the software developed to implement the AMTRAN (Automatic Mathematical Translation) language on the IBM 1130 computer with 8K of core. A description of the language and full documentation of the software system are included. Author

N70-41320# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.
DIGITAL DETERMINATION OF THE MECHANICAL SPEED OF ROTATION AND CONVERSION USING AN ANALOG COUNTING TECHNIQUE [UEBER DIE DIGITALE BESTIMMUNG MECHANISCHER DREHGESCHWINDIGKEITEN UND UEBERSETZUNGEN MIT EINEM LUECKENLOS ARBEITENDEN ZAEHLVERFAHREN]
Dietmar Affeldt (Ph.D. Thesis) 1968 165 p refs In GERMAN
Avail: NTIS

A continuously operating digital measuring technique for determining angle of rotation errors and coefficient of fluctuation of rotatory waves is described. The counter is capable of making 1000 measurements per second with a minimum time-limit release of 1 microsecond. Recording of the total count is accomplished by analog evaluation of each individual number at each level and plotting is accomplished by a flying-spot scanner. Transl. by R.B.

N70-41341# Sandia Labs., Albuquerque, N.Mex.
ANNOUNCEMENT OF THE AVAILABILITY OF ERF AND ERFC, MATHEMATICAL ROUTINES FOR COMPUTING THE ERROR FUNCTION AND COMPLEMENTARY ERROR FUNCTION
J. E. Vogel Jul. 1970 4 p
(SC-M-70-388) Avail: NTIS

Subroutines ERF and ERFC are applicable for the computing system Control Data 6600 SCOPE, and may be maintained for the convenience of the user in a library file. The routines are accessible by means of a few machine-dependent control cards. They are written as function subprograms and an entry reference may be made anywhere an arithmetic expression is allowed. E.M.C.

N70-41380# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
AED-0 PROGRAMMER'S GUIDE
Clarence G. Feldmann, ed., Douglass T. Ross, and Jorge E. Rodriguez Jan. 1970 341 p Prepared in cooperation with Cambridge Computer Associates, Inc.
(Contract F33615-69-C-1341)
(AD-866123; ESL-R-406) Avail: NTIS CSCL 9/2

The AED (Automated Engineering Design) System has been developed over a 10-year period by the M.I.T. Computer-Aided Design Project. The report is a user reference manual for the AED-0 language and the Version 3 AED-1 compiler and associated system building packages, as released in July, 1969 for use on IBM 360-series computers in both batch-oriented and time-sharing operating systems. Part 1 of the manual describes the AED-0 language proper, including descriptions of several subroutine packages which extend the features of the language beyond the forms derived from Algol-60 syntax. Part 2 describes additional subroutine packages useful as building blocks for general software construction. Bootstraps of AED to other computers were partially completed under the contract, and are being completed outside M.I.T. The report will also serve as a user reference manual for these versions. Author (TAB)

N70-41381# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
INTRODUCTION TO SOFTWARE ENGINEERING WITH THE AED-0 LANGUAGE
Douglas T. Ross Oct. 1969 245 p Prepared in cooperation with Cambridge Computer Associates, Inc.
(Contract F33615-69-C-1341)
(AD-863500; ESL-R-405) Avail: NTIS CSCL 9/2

The report is a tutorial exposition of the AED-0 language and of a software engineering discipline based upon its use. The AED (Automated Engineering Design) System has been developed over a ten-year period by the M.I.T. Computer-Aided Design Project, culminating in release of the Version 3 AED-1 Compiler and associated system-building systems for use on IBM 360-series computers in both batch and time-sharing. Bootstraps to other computers are in progress. The AED-0 language, based on ALGOL-60, is the present language for the AED-1 Computer. The report describes a major subset of the AED-0 language and demonstrates its use. Author (TAB)

N70-41384# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.

DIGITAL COMPUTER CIRCUITS [LEITUNGEN IN DIGITALRECHNERN]

Herbert Stopper (Ph.D. Thesis) 1968 138 p refs In GERMAN

Avail: NTIS

The given investigation of digital computer circuits is based on classical high frequency technology and modern digital techniques. It is shown that TEM waves can propagate in only a longitudinal direction in a uniform multiple circuit system of (n + 1) circuits with up to n different phase shifts. An imaginary voltage-current wave, corresponding to the simple TEM wave in the two-wire circuit, is defined for each phase shift. The transformations between the real voltages, currents, and impedances and the imaginary voltage-current waves and their surge impedances are derived. Only the given values for both special cases of the arbitrary 'two-phase circuit' and the 'zero-symmetrical multiphase circuit' explicitly dependent on the capacitive, inductive, and resistive coverings of the conductor are calculated. The two-terminal properties of fast switching circuits are investigated with respect to their input and output. On the basis of the studies, a transmission system is proposed which is characterized by a standard circuit with specific electrical and mechanical properties and by specific handicaps for the transfer properties of passive switching circuits. Transl. by R.B.

N70-41401# Academy of Sciences (USSR), Moscow.

PROBLEMS IN DATA PROCESSING, SECTION 5 Conference Proceedings

1969 174 p refs In RUSSIAN 4th Conf. on the Theory of Inform. Transmission and Coding, Tashkent, 29 Sep.–4 Oct. 1969 Prepared by Sci. Soviet on the Complex Probl. of Cybernetics and Inst. of Inform. Transmission Probl. of Acad. of Sci. USSR, Cybernetics Inst. and Computer Center of Acad. of Sci. Uzbek SSR, and Sci. and Tech. Soc. of Radio Eng. and Telecommun. imeni A. S. Popov

Avail: NTIS

Papers presented include information on signal encoding, error detection and coding, noise reduction, linear prediction, data transmission, circuit reliability, and multiplexing. For individual titles see N70-41402 to N70-41431.

N70-41402# Academy of Sciences (USSR), Moscow.

ON MEASURING DATA FLOW IN SYSTEMS WITH CYCLIC INTERROGATION

D. A. Abdullaev *In its* Probl. in Data Process., Sect. 5 1969 p 3–8 refs In RUSSIAN (See N70-41401 23-08)

Avail: NTIS

A system is analyzed containing three control parameters with appropriate sensors. A comparator is placed on a central control point to cyclically interrogate the sensors. An apparatus is included at the comparator output for preprocessing of data by comparing actual measurement values with standard values. The communication distribution density at the comparator output is defined. Systems with predicted standards are cited as examples. Transl. by E.C.

N70-41403# Academy of Sciences (USSR), Moscow.

QUESTIONS ON THE THEORY OF OBJECT CLASSIFICATION IN LIGHT OF ALGEBRAIC THEORY OF CORRECTING CODES

G. Ananiashvili *In its* Probl. in Data Process., Sect. 5 1969 p 9–13 refs In RUSSIAN (See N70-41401 23-08)

Avail: NTIS

Statistical modeling procedures used in pattern recognition are mentioned, and a recognition problem is described using correcting code terminology. A given combination of d-measuring standards of objects with an arbitrary but known probability distribution is used to obtain a recognition or classification matrice. Transl. by E.C.

N70-41411# Academy of Sciences (USSR), Moscow.

SCOPE OF THE OCCURRENCE OF BLOCK CODING SPECTRA WITH SPECIFIED MINIMAL SPACING

I. Ya. Goldbaum *In its* Probl. in Data Process., Sect. 5 1969 p 46–51 refs In RUSSIAN (See N70-41401 23-08)

Avail: NTIS

Examples are discussed for the optimization of a digital transmission system with block coding and exponents that are dependent on the code spectra being used. Data on the spectra region of an n, d sub min, g code support both statistical and dynamic optimization in terms of mathematical programming. The problem object function is an optimized function or integral criterion. Transl. by E.C.

N70-41413# Academy of Sciences (USSR), Moscow.

CYLIC ARITHMETIC CODES

Yu. G. Dadaev *In its* Probl. in Data Process., Sect. 5 1969 p 55–60 In RUSSIAN (See N70-41401 23-08)

Avail: NTIS

An equation is derived for a cyclic subquantity in a binary system notation. The integer modulo 2 sup n-1 is used to represent algebraic elements for the binary sequences with a length of n. Theorems are presented for a cyclic arithmetic code, and cases are treated for a Mersen index integer n with either even or odd numbers, as well as for primitive codes. Findings show that the cyclic AN-code is ideal in the algebra of whole integers using modulo 2 sup n-1. Transl. by E.C.

N70-41414# Academy of Sciences (USSR), Moscow.

CYCLIC CODES FOR CORRECTING RECURRING ARITHMETIC ERRORS

V. N. Dynkin, G. M. Tenengolts, and G. I. Khabelashvili *In its* Probl. in Data Process., Sect. 5 1969 p 61–65 refs In RUSSIAN (See N70-41401 23-08)

Avail: NTIS

Cyclic functions of an AN-code were analyzed by determining an appropriate residue system in accordance with a P modulo. The code displays a much greater capacity for correcting arithmetic errors than a similar code having the same length and distance. Transl. by E.C.

N70-41415# Academy of Sciences (USSR), Moscow.

APPLICATION OF CORRECTING CODES FOR OPERATIONAL CONTROL OF DIGITAL SERVO-SYSTEM

I. L. Erosh, V. V. Losev, and V. N. Nomokonov *In its* Probl. in Data Process., Sect. 5 1969 p 66–70 In RUSSIAN (See N70-41401 23-08)

Avail: NTIS

Failure detection techniques using correcting codes as applied to a digital servomechanical measuring unit are reviewed. The measuring unit comprises a time discriminator, and digital integrator and actuating device; which consists of a phaseshifter, frequency divider, and a counter. The development of operational control circuits for the unit components is discussed. Transl. by E.C.

N70-41416# Academy of Sciences (USSR), Moscow.
METHOD FOR CONTROLLER AUTOMATON CODING UNDER A RESTRICTED BRANCHING COEFFICIENT OF MEMORY ELEMENTS
V. M. Zenin *In its* Probl. in Data Process., Sect. 5 1969 p 71–76 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

A method is presented for coding data on the internal state of automatic control equipment with allowance made for a given coefficient of memory branching elements, which provide operational control and simplify the equipment structure. The aim is to identify a coding method using a composite code with a weight of two while introducing a minimum amount of memory elements. Transl. by E.C.

N70-41417# Academy of Sciences (USSR), Moscow.
NOISE SUPPRESSION OF DIODE-TRANSISTORIZED LOGIC ELEMENTS OF ELECTRONIC DIGITAL COMPUTERS
S. A. Ikramov *In its* Probl. in Data Process., Sect. 5 1969 p 77–84 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Problems of calculating the unstable magnitudes of electric component parameters in digital computers are discussed with emphasis on the static and dynamic stability of logic circuits. Transl. by E.C.

N70-41420# Academy of Sciences (USSR), Moscow.
SOME PROPERTIES OF THE CODING TREE
N. G. Nayanzin *In its* Probl. in Data Process., Sect. 5 1969 p 103–108 ref In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

A k-tiered coding tree with equal distribution of a finite number of inputs through all its circuits is given. The number of all possible inputs of the tree is equal to (m + 1) to the k-th power, to each of which a specific set of length k is placed in agreement. The individual sets comprise the collection of sets M. The components of the set are denoted by x,y; the properties of the set by d; the number of sets having the property d sub 1 ... d sub e by N(d sub 1 ... d sub e); and the weight of the set by beta. The various properties of the sets are derived and calculated. Transl. by R.B.

N70-41421# Academy of Sciences (USSR), Moscow.
METHODS OF CODING INTERNAL STATES OF FINITE AUTOMATA
N. K. Nemsadze *In its* Probl. in Data Process., Sect. 5 1969 p 109–110 In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

The problem of increasing the structural reliability of a finite automaton, the memory block of which consists of n internal memory elements, by proper encoding of its M internal states is investigated. It is assumed that the elements of the automaton combination block are not damaged and that the logic circuits in the specific automaton are disregarded. Special C-matrix codes having a given volume, length, and distance are constructed. The upper bound for n is established and a method for constructing C-matrices with a given number of rows is described. Transl. by R.B.

N70-41422# Academy of Sciences (USSR), Moscow.
VARIOUS CLASSES OF CODES USED IN COMPUTER CHANNELS
V. M. Ostianu, V. F. Lyakhovich, and A. I. Potekhin *In its* Probl. in Data Process., Sect. 5 1969 p 111–117 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Error correction codes, developed to increase data transmission reliability along communication channels, are proposed for increasing the reliability of data processing in computer channels. The main problem is optimum reliability with given redundancy or minimum redundancy with given reliability. Methods of coding applicable in solving the problem of minimum redundancy with given reliability are emphasized. Transl. by R.B.

N70-41423# Academy of Sciences (USSR), Moscow.
A METHOD OF NONLINEAR PROGRAMMING OF AN AUTOMATON WITH A MULTIPLE-ERROR-CORRECTING MEMORY
A. V. Pastukhov *In its* Probl. in Data Process., Sect. 5 1969 p 118–123 ref In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Methods of increasing the reliability of finite automata by introducing redundancy based on the properties of error-correcting codes are considered. The possibility of using codes which take into account the effect of data reduction is shown for programming the internal states of an automaton with memory circuits. Transl. by R.B.

N70-41424# Academy of Sciences (USSR), Moscow.
USING NOISE-IMMUNE CODING TO CORRECT ERRORS IN THE EXTERNAL STORAGE OF COMPUTERS
S. A. Popova *In its* Probl. in Data Process., Sect. 5 1969 p 124–130 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Algorithmic methods of detecting and correcting errors are considered for increasing the noise suppression characteristics in recording and readout of digital data in the external storage of computers. The recording and digital data readout channels are represented by real-time error sequences derived from experimental studies of storage devices. The derived error sequences are given in tabular form as a function of frequency per binary digit and per word. Transl. by R.B.

N70-41425# Academy of Sciences (USSR), Moscow.
CERTAIN PROPERTIES OF m-OUT-OF-n COMMUNICATION SYSTEMS WITH CODING IN THE SEMICONTINUOUS CHANNEL
Yu. P. Pyatoshin *In its* Probl. in Data Process., Sect. 5 1969 p 131–134 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

A communication system with m (m = or > 2) equidistant signals in the presence of additive Gaussian white noise is considered. Problems similar to those considered for the case of a digital channel (digital m-out-of-n input and output) in a previous paper are investigated for the case of a semicontinuous channel (m-out-of-n digital input and analog output). A binary sequence of data characters are fed into the input of the system. The sequence is then transformed into an m-out-of-n system, encoded, and fed into the channel. Maximum distribution for the sums of dependent random variables and the probabilities of large deviations are found for the semicontinuous channels. Transl. by R.B.

N70-41426# Academy of Sciences (USSR), Moscow.
DECODING IN AUTOMATA
Yu. L. Sagalovich *In its* Probl. in Data Process., Sect. 5 1969 p 135–137 ref In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

The problem of constructing a combination automaton block with error-correcting coding of automaton states is considered for the case when only the storage elements are assumed to be unreliable. It is shown that the complexity of the decoding scheme and the number of calculations in decoding are significantly reduced by using a linear code for threshold encoding. Transl. by R.B.

N70-41427# Academy of Sciences (USSR), Moscow.
CONVOLUTED BLOCK ERROR-CORRECTING PROGRAMMING
S. I. Samoylenko and V. I. Breusov *In its* Probl. in Data Process., Sect. 5 1969 p 138–146 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

A method is considered for combining sequential decoding of convoluted codes with block decoding of codes developed for programming machine data. Derivation of block and convoluted codes is described for each separately, and it is shown that by using the two codes together, a code with combination error-correcting capabilities is possible. Transl. by R.B.

N70-41428# Academy of Sciences (USSR), Moscow.
COMPOSITE ARITHMETICAL CODES
V. N. Saskovets, V. I. Andrianov, I. L. Yerosh, and O. A. Belyayev *In its* Probl. in Data Process., Sect. 5 1969 p 147–151 ref In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Let the number C belong to an arithmetical code A sub 0 N and let there be codes A sub 0 A sub 1 N with M(A sub i, d sub i) code words (i = 1, 2, 3, ... l). The remainders R sub i from division of the number C by the moduli A sub i are found. The remainders R sub i are encoded using a certain class of arithmetical codes (B sub i) i = 1,2,... l, R sub i approaches the limit of b sub i, where by sub i is a member of B sub i. Assigning the symbols of code words b sub i to those of the number C, the word (C : b sub 1 : b sub 2 : ... : b sub e) of a certain arithmetical code is obtained. The set of M(A sub i,d sub i) words, constructed according to the given method, is called a composite arithmetical code. Composite codes are shown to be more suitable for error correction than equivalent indivisible codes. Transl. by R.B.

N70-41429# Academy of Sciences (USSR), Moscow.
PROBLEMS OF EVALUATING THE EFFECTIVENESS OF ARITHMETICAL ERROR DETECTING AND CORRECTING CODES IN ELECTRONIC COMPUTERS
N. N. Trofimov *In its* Probl. in Data Process., Sect. 5 1969 p 153–160 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

Specific values for the effectiveness of such codes are calculated and recommendations are made for using them in computers. The relationship between the computer capacity reserve, the malfunction rate, the error correction time, and the type of arithmetical code used to detect and correct errors is established according to the developed methodology. This relationship permits calculation of one of the given parameters by the remaining ones, and the approach to simplification of the solution is to calculate the specific value of the parameter from limited information about the remainder. Transl. by R.B.

N70-41431# Academy of Sciences (USSR), Moscow.
ERROR MULTIPLICATION IN DECODING CYCLIC CODES
Sh. Yanyshev *In its* Probl. in Data Process., Sect. 5 1969 p 167–172 refs In RUSSIAN (See N70-41401 23-08)
Avail: NTIS

A model of the Bose-Chaudhuri code using the Peterson algorithm for decoding is discussed. It is shown that error multiplication is a function of noise intensity in the channel and does not depend on the entropy of the message source. The necessary changes in the basic Peterson model are pointed out and the different situations arising when investigating the multiplication effect are indicated. Transl. by R.B.

N70-41502 National Lending Library for Science and Technology, Boston Spa (England).
PRELIMINARY ASPECTS OF COMPUTERISED ACQUISITION AND COMMAND ON THE CERN PROTON SYNCHROTRON AND BOOSTER
E. Asseo et al 8 Jun. 1970 13 p refs Transl. into ENGLISH of CERN report MPS/INT-CO-67-12
(NLL-LB/9/2742-(9091.9F); MPS/INT-CO-67-12) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The type of interface required between the computer and instrumentation was defined to obtain a system which will be more centralized, flexible, operationally reliable and compact, and automatic or capable of being so. The system must also have a program which allows operator and computer to communicate through the interface, via a console, on the initative of the operator or as directed. Manual operation bypassing the computer must be possible. Data acquisition and control systems are defined. The system is designed for the proton synchrotron but it must also be capable of extending to the booster. E.H.W.

N70-41560# RAND Corp., Santa Monica, Calif.
JASP: A SIMULATION LANGUAGE FOR A TIME-SHARED SYSTEM
A. Pritsker and B. Alan Jun. 1970 124 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-709177; RM-6279-PR) Avail: NTIS CSCL 9/2

A combination Users Manual and Programmers Guide is provided for JASP, a simulation language for use on the JOSS time-shared system. Written in JOSS language, JASP provides standard routines for performing functions that are common to many simulations: initialization; time and event control; information storage and retrieval; performance data collection; summary, monitoring, and error reporting; and random deviate generation. The routines for performing each of these functions are described, as well as the specially defined JOSS variables used by JASP. The JASP framework for creating a simulation model follows that used in SIMSCRIPT and GASP. Simulations of a simple queueing system and a man-machine price and inventory system are used to illustrate areas for which JASP is designed. The memorandum provides complete documentation and ready-reference for JASP statement types, part interactions, and JOSS coding. Author (TAB)

N70-41597# RAND Corp., Santa Monica, Calif.
SECURITY OF COMPUTERIZED INFORMATION SYSTEMS
Rein Turn and H. E. Petersen Jul. 1970 9 p refs Presented at the Carnahan Conf. on Electron. Crime Countermeasures, Lexington, Ky., 16-18 Apr. 1970
(AD-709366; P-4405) Avail: NTIS CSCL 9/2

The paper addresses the vulnerabilities of remotely accessible computerized information systems to electronic crime -- penetration of the information system for illicit copying, altering or destruction of selected information. A condensed survey of the probable threats and applicable countermeasures is presented. A particular emphasis is placed on the use of cryptographic techniques for protecting information in the communication lines and in computer files. Author (TAB)

N70-41609# Auburn Univ., Ala.
MULTIPROCESSOR COMPUTER SYSTEMS
J. D. Irwin, J. M. Thornton, Jr., and U. S. Blanco Jul. 1970 97 p refs
(Contract DAAH01-68-C-0298)
(AD-709599; AU-T-12) CSCL 9/2

Multiprocessor computer systems are investigated by studying the control and synchronization needed in their design. Attention is focused on problems created by operating in a multiprocessor environment. The system under consideration is broken down into elements, all of which are described in detail. All arithmetical and logical operations of the system are performed by the Computing Element. This elements problems such as, Task Assignment Lists

and Processor Control are discussed. Memory procedures presented include memory space allocations, conflict resolutions, and routines. System configurations and graceful degradation are also presented. Finally the IBM Systems 9020, which is a current example of a multiprocessor is examined. Author (TAB)

N70-41649# RAND Corp., Santa Monica, Calif.
PROGRAMMING: THE QUIET EVOLUTION
G. D. Brown Jul. 1970 12 p
(AD-709536; P-4417) Avail: NTIS CSCL 9/2

The report briefly describes past, present, and future trends in computer programming and its effects on computer programmers. TAB

N70-41650# Michigan Univ., Ann Arbor.
THE AUDIO RESPONSE UNIT USER'S GUIDE
Douglas Burr Smith Apr. 1970 28 p refs
(Contract DA-49-083-OSA-3050)
(AD-709501; TR-27) Avail: NTIS CSCL 9/2

The report describes the characteristics and use of the IBM 7772 Audio Response Unit as supported by the University of Michigans terminal system. The following subjects are discussed: data transmission, device commands, and text-to-speech translation. Author (TAB)

N70-41651# Auburn Univ., Ala.
MULTIPROCESSING BIBLIOGRAPH
J. D. Irwin and J. M. Thorington, Jr. Jul. 1970 54 p refs
(Contract DAAH01-68-C-0296; Proj. Themis)
(AD-709600; THEMIS-AU-T-13) Avail: NTIS CSCL 9/2

References associated with the area of multiprocessing have been collected and organized into a bibliography which is divided into the seven following sections: (1) Papers in alphabetical order by main authors last name; (2) General information; (3) Preemptive and non-preemptive scheduling of tasks; (4) Models and simulations of multiprocessing systems; (5) Memory types, allocations, protections, and simulations; (6) Multiprogramming, time-sharing, and parallel processing; (7) Systems using multiprocessing. Author (TAB)

N70-41652# Bradford Computer and Systems, Inc., N.Y.
CONPLOT 1: A CONTOUR GENERATING PROGRAM Final Report
B. Fleshel, A. J. Stewart, and M. Gilman May 1970 181 p
(Contract DAAK02-69-C-0487)
(AD-709675; USAETL-CR-70-2) Avail: NTIS CSCL 8/2

A contour generating system (CONPLOT I) is described whose input is a UNAMACE created magnetic tape. Output of this system are cartographic quality contour maps which can be combined to form larger maps. These contour maps include (a) Universal Transverse Mercator Grid, (b) variable contour levels, (c) labelled and broadened index contours, (d) depression indications, and (e) a variable output plotting scale. The following data handling techniques are used: (a) parallel processing, (b) random access, (c) binary searching, and (d) binary sorting. The internal processing of the input data includes (a) redundant data elimination, (b) noise elimination and data smoothing by either an Area Smoothing Algorithm or a Least Squares Smoothing Algorithm, (c) contour smoothing equations and (d) fitting of resultant contours to streams to insure natural appearing intersections. The report also includes an analysis and a discussion of algorithms used for contour map shading. TAB

N70-41664# Air Force Office of Scientific Research, Arlington, Va.
IS REAL-TIME, ON-LINE OPTIMAL FLIGHT CONTROL FEASIBLE?
Allen D. Dayton Jun. 1970 85 p refs
(AD-709714; AFOSR-70-1379TR) Avail: NTIS CSCL 1/3

The document discusses an edited transcript of a special panel discussion Is Real-Time, On-line Optimal Flight Control Feasible held by the Theory Committee of the American Automatic Control Council on 5 August 1969 in conjunction with the 1969 Joint Automatic Control Conference, at Boulder, Colorado. The panel considered the problems associated with controlling an aircraft in such a way as to optimize some performance criterion. Specific subjects discussed include optimization theory and techniques, aerospace computer technology, and numerical procedures. A description of a current NASA project in this area is presented. Comments from the audience are also presented. Author (TAB)

N70-41690# Radio Corp. of America, Princeton, N.J.
ON THE IMPLEMENTATION OF THE DESCRIPTIVE DATA BASE, BASED ON CDL1
Chitoor V. Srinivasan Feb. 1970 30 p refs
(Contract F19628-68-C-0070)
(AD-709224; SR-4; AFCRL-70-0184) Avail: NTIS CSCL 9/2

In previous reports, CDL1 (a computer description language) has been defined and discussed. The report discusses the implementation of a system of programs, on the RCA Spectra 70 computers, to generate appropriate file structures from computer descriptions written CDL1. This translation to a DDB (descriptive data base) involves syntactic analysis and a certain amount of checking for internal consistency, as well as the creation of directory entries, etc. Once the type of DDB's described in this report can be generated, a variety of design-aid systems can be based upon them, saving a duplication of effort, guaranteeing an integrated overall system, and avoiding built-in obsolescence. Author (TAB)

N70-41696 National Lending Library for Science and Technology, Boston Spa (England).
THE STAR TRANSCODER: RAPID CONVERSION OF A DIGITAL QUANTITY, EXPRESSED IN STRAIGHT BINARY, INTO A BINARY-CODED DECIMAL FORM BY MEANS OF A PURELY COMBINATORY ITERATIVE PROCEDURE (ARITHMETICAL DIVISION)
E. Asseo 8 Jun. 1970 12 p Transl. into ENGLISH of CERN MPS/INT-CO-67-8
(NLL-LB/9/2743-(9091.9F); MPS/INT-CO-67-8) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A transcoder for retrieving digital input data (STAR) from the IBM 1800 computer is considered. The output values are required in straight binary and BCD, which requires that quantitative data arising from the computer in straight binary be converted into BCD 8-4-2-1 form. To avoid modifying the operating sequences of the system the transducer must be a purely combinatory fast-response device, and an iterative system. The complete circuit for an adding module with two 4-bit words is included. F.O.S.

N70-41698# MITRE Corp., Bedford, Mass.
PRINCIPLES OF OPERATION OF THE VENUS MICROPROGRAM
Barbara J. Huberman Jul. 1970 114 p
(Contract F19628-68-C-0365)
(AD-709717; MTR-1843; ESD-TR-70-198) Avail: NTIS CSCL 9/2

Venus is a computer system comprised of microprograms and software. It is implemented on the Interdata 3, which is a small, microprogrammable computer. The document contains a complete description of the microprogram part of Venus. Author (TAB)

N70-41701# Oak Ridge National Lab., Tenn.
HIGH-SPEED SCAN PROGRAMS FOR THE HFIR DIGITAL CONTROL AND DATA ACQUISITION SYSTEM

H. P. Danforth 20 Apr. 1970 31 p refs Sponsored by AEC (ORNL-TM-2931) Avail: NTIS

Four computer programs were developed to allow simple operator control of high-speed scanning of particular reactor variables for subsequent reactor diagnosis studies. An explanation of the program and hardware operations for interpreting operator console switches, setting up analysis parameters, establishing scanning frequency, storing the data on the drum memory, and initiating the power spectral density analysis of a fluctuating signal is presented. Author (NSA)

N70-41723# International Business Machines Corp., San Jose, Calif. Research Lab.

FORMATTED FILE ORGANIZATION TECHNIQUES Final Technical Report

Michael E. Senko, V. Y. Lum, F. P. Palermo, S. P. Ghosh, and P. J. Owens Griffiss AFB, N.Y. RADC Jun. 1970 302 p refs (Contract F30602-69-C-0097) (AD-709679; RADC-TR-70-90) Avail: NTIS CSCL 9/2

The report contains papers presenting several useful steps toward the creation of a more scientific discipline of formatted file design. In particular, there are papers on: (1) The first extensive, fundamentally oriented comparison of key-to-address transforms utilizing existing formatted files. (2) Formal, mathematical descriptions of formatted file systems that are used to provide concepts and means to deal with: (a) the selection of indexes, (b) direct retrieval on the basis of multiple attributed, and (c) questions of storage and response time efficiency. (3) The new calibration of the FOREM I Formatted File Organization Simulation Model. (4) A new, more powerful 9000 FORTRAN statement model (FOREM II) for simulating the effects of complex file organizations, and machine configurations on efficiency and response times in a formatted file query and update environment. Author (TAB)

N70-41749# System Development Corp., Santa Monica, Calif.

ABSTRACT FAMILIES OF LANGUAGES GENERATED BY BOUNDED LANGUAGES

Jonathan Goldstine 4 Jun. 1970 141 p refs (Contract F19628-70-C-0023; AF-AFOSR-1203-67) (AD-709416; SR-6; TM-738/059/00; AFCRL-70-0385) Avail: NTIS CSCL 9/2

An AFL is defined to be bounded if it is generated by a set of bounded languages. It is shown that the smallest full AFL containing a bounded AFL is itself a bounded AFL. An AFL is exhibited which is contained in a bounded AFL but which is not itself bounded. It is shown that a bounded AFL containing a non-regular set cannot be closed under substitution. If g is any set of bounded languages, it is shown that the smallest intersection closed AFL containing g cannot contain all recursively enumerable languages. In contrast, a one-letter language L is exhibited for which the smallest intersection closed full AFL containing L does contain all recursively enumerable languages. A set g of languages is independent if every proper subset of g fully generates a smaller full AFL than g does. It is shown that there exist infinite independent sets of languages. A representation in terms of multitape sequential transducers is given for each language in the smallest intersection closed (full) AFL containing a given language. Author (TAB)

N70-41778# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

AMBIGUITY IN GRAPHS AND EXPRESSIONS

Ronald Book, Shimon Even, Sheila Greibach, and Gene Ott May 1970 23 p refs (Contract F19628-68-C-0029) (AD-709711; AFCRL-70-0330; SR-3) Avail: NTIS CSCL 9/2

A regular expression is called unambiguous if every tape in the event can be generated from the expression in one way only. The flow-graph-technique for constructing an expression is shown to preserve ambiguities of the graph, and thus, if the graph is that of a deterministic automaton, the expression is unambiguous. A procedure for generating a nondeterministic automaton which preserves the ambiguities of the given regular expression is described. Finally, a procedure for testing whether a given expression is ambiguous is given. Author (TAB)

N70-41800*# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Electrical Engineering.

A STUDY OF DIGITAL TECHNIQUES FOR SIGNAL PROCESSING Semiannual Status Report, 1 Feb. – 31 Jul. 1970

Mischa Schwartz and Robert R. Booratyn 31 Jul. 1970 21 p refs (Grant NGR-33-006-040) (NASA-CR-114124) Avail: NTIS CSCL 09D

Research activities are briefly reported on adaptive array processing, dynamic programming, digital data transmission, recursive adaptive equalizers, and finite memory communication systems. Work on adaptive array processing emphasized a fast computer algorithm for designing detector arrays and simulated adaptive structures. Dynamic programming techniques were applied to the design of adaptive equalizer and development of other simple equalization schemes. An adaptive maximum likelihood receiver for digital data transmission over channels with intersymbol interference is described. Recursive adaptive filters for minimizing the intersymbol distortion of a communication channel is analyzed. Finite memory machines, with two and three state memories, are described for studies in converting communications systems to digital processing. N.E.N.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N70-40431 Arizona Univ., Tucson.

MONOLITHIC HIGH Q BAND-PASS FILTERS EMPLOYING ELECTRO-THERMAL CIRCUITS

Miles Franklin Friedman (Ph.D. Thesis) 1969 143 p Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-18407

Highly selective integrated bandpass filters are shown to be realizable with electrothermal circuits in a thermally insulated silicon monolithic structure. A frequency translation filter is developed which achieves its bandpass characteristic through low-pass to bandpass transformations of thermal low-pass transfer functions. The two-channel differential filter system is implemented with matched bipolar transistor pairs and low-value resistors. Quadrature signals at the filter center frequency, required for the frequency translations, are employed in a manner that renders the filter response relatively insensitive to their amplitude and quadrature phase. The filter may be tuned by varying the frequency of the quadrature signal source. The basic filter building block is a monolithic thermal element that realizes a low-pass thermal transfer characteristic between its diffused heater and temperature sensor. Dissert. Abstr.

N70-40437# Chicago Aerial Industries Inc., Barrington, Ill.

FIBER OPTICS WITH HIGH ULTRAVIOLET TRANSMISSION Final Report, 29 Mar. 1966 – 30 Apr. 1970

Louis J. Richter Jun. 1970 56 p (Contract DA-28-043-AMC-02057(E))

(AD-708579; CAI-7521-F; ECOM-02057-F) Avail: NTIS CSCL 20/6

U. S. Army Electronics Command specified the best effort development of fiber optic faceplates for cathode-ray tubes (CRTs) with high transmission in the 3700 A region. A design goal of 85 percent transmission in the region of interest was established. A glass having high transmission in this region was developed which was satisfactory for drawing into fibers, and faceplates were fabricated from this glass. The faceplates were 1/4-inch thick and exhibited a transmission of 90 percent with the desired wavelength. One faceplate was successfully incorporated into a high resolution, high-UV performance CRT. This tube will far surpass presently existing tubes for annotation of ultra-violet sensitive dry process films. TAB

N70-40445# Army Electronics Command, Fort Monmouth, N.J.
SIMPLIFIED MAGNETRON INJECTION GUN NOISE THEORY Research and Development Technical Report
Paul Fischer May 1970 32 p refs
(AD-708546; ECOM-3274) Avail: NTIS CSCL 9/1

The report describes a simplified noise theory useful in the esign and evaluation of magnetron injection guns. The results of the analysis have been programmed for a digital computer to facilitate application. Graphs are presented which predict qualitative noise behavior common to all magnetron injection guns as an illustration of the use of the theory. Several new phenomena predicted by the theory are also described in some detail. Author (TAB)

N70-40477 Missouri Univ., Rolla.
MODELS FOR THE p-n DIODE AND THE n-p-n AND p-n-p TRANSISTOR FOR USE IN COMPUTER AIDED DESIGN AND ANALYSIS PROGRAMS
Glenn Ronald Case (Ph.D. Thesis) 1969 234 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 69-19424

The problem of developing suitable mathematical representations for the pn junction diode and npn and pnp transistors for use in computer aided design and analysis programs is considered. The Ebers-Moll model as used in the Net-1 program has been considerably improved, particularly regarding base resistance prediction, prediction of high forward current behavior, and the addition of reverse breakdown terms. The resulting models show substantial improvement in representation of d-c and transient characteristics. Some improvement in a-c characteristics was also obtained. Methods of obtaining parameters for the new model and several of the present models, given measured device characteristics, are also described. Physical device operation is described to the extent necessary to justify the assumptions made in model formulation. Dissert. Abstr.

N70-40499# Army Electronics Command, Fort Monmouth, N.J.
SLOT LINE FILTERS AND COUPLERS Research and Development Technical Report
Elio A. Mariani and John P. Agrios Jun. 1970 35 p refs
(AD-708864; ECOM-3293) Avail: NTIS CSCL 9/5

The report presents experimental data concerning the performance of band-pass and band-stop filters and a hybrid coupler; the work described was performed at S-band frequencies using the single substrate slot line geometry. Also included are theoretical data concerning the slot-line wavelength and characteristic impedance for the case of the slot line configuration having dielectric material above and below the metallization, the so-called slot line sandwidth. Author (TAB)

N70-40504# Kentucky Univ., Lexington. Dept. of Chemistry.
A 4 KHZ CRYSTAL OSCILLATOR
Dieter Britz and Henry H. Bauer Feb. 1970 6 p ref
(Contract DAAB07-69-C-0366; Proj. Themis)
(AD-708882; THEMIS-UK-RR-9) Avail: NTIS CSCL 9/5

The standard circuit for a 4 kHz crystal oscillator has been modified in order to attain an undistorted sinusoidal output together with rapid initiation of oscillation and good stability. The output is 0 to 5 V r.m.s. at 4000.0 Hz. Author (TAB)

N70-40617# Army Electronics Command, Fort Monmouth, N.J.
NOISE QUALITY MEASUREMENTS FOR MICROWAVE NOISE GENERATORS
Calvin D. Bates May 1970 47 p refs
(AD-708872; ECOM-3275) Avail: NTIS CSCL 9/5

Measurement techniques for characterizing the noise output of microwave noise generators are described. The aim of these measurements is to formulate a quantitative basis for the comparison, selection and utilization of microwave noise generators. Three measurements, namely: the power density spectrum, the autocorrelation function, and the probability density function (PDF) are discussed. Experimental results for a crossed-field noise generator are shown. A computer program which was formulated to determine the statistics of the measured PDF and permit comparison of test results with a normal distribution is also discussed. Experimental results and analysis of two different noise spectra are also included to illustrate the utility of the noise measurement techniques. Author (TAB)

N70-40633# Harry Diamond Labs., Washington, D.C.
A FLUIDIC AMMETER FOR MEASURING CURRENT IN BRIDGE WIRES
Jonathan E. Fine May 1970 34 p refs
(AD-708549; HDL-TM-70-7) Avail: NTIS CSCL 14/2

A fluid system to measure current induced in electronic circuits by radiofrequency electromagnetic radiation is discussed. The system consists of two temperature-sensitive flueric oscillators, one containing a bridge wire. Current in the bridge wire produces heat that increases the driving gas temperature, hence, frequency of one oscillator. The frequency increase depends on the amount of current through the bridge wire. The other oscillator provides a reference signal at a lower frequency. The beat frequency that results on mixing the signals from the two oscillators is amplified with a proportional amplifier and transmitted acoustically out of the radiation environment. Author (TAB)

N70-40648 National Lending Library for Science and Technology, Boston Spa (England).
CRYOGENIC AC ELECTRIC MOTORS
I. D. Kolodeev 22 Jun. 1970 14 p refs Transl. into ENGLISH of VINITI Reports Library, Moscow, Reference No. 351-68 Dep.
(NLL-CE-Trans-5416-(9022.09); Rept-351-68-Dep) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The described cryogenic electric motors were tested for performance in liquid and gaseous helium at a temperature of 4.2 K without load and under conditions of agitation of the liquid helium. The superconducting electromagnetic suspensions of the rotor developed a stiffness sufficient for normal operation of the motors for periods up to 5 hrs. The nominal speed of the rotor under conditions of agitation of the liquid helium is 1200 rpm with a current in the stator winding of 1 A compared to motors with permanent magnets which have speeds of 3000 rpm and a stator current of 0.5 A. The theoretical thermal losses in the stator do not exceed 0.3 W under nominal conditions. Author

N70-40674# Army Electronics Command, Fort Monmouth, N.J.
ANALYSIS AND APPLICATION OF GALLIUM ARSENIDE AVALANCHE TRANSIT TIME DEVICES Research and Development Technical Report
Joseph J. Baranowski and Vincent J. Higgins May 1970 31 p refs
(AD-708865; ECOM-3278) Avail: NTIS CSCL 9/1

The report describes a unique theoretical design which has advanced the performance of avalanche transit time diodes for the direct generation of coherent microwave energy. A rigorous computer aided analysis is presented which solves the continuity equations and Poissons equation for an avalanching electron hole plasma. The theoretical characterization of these devices with respect to AC impedance and noise performance is obtained and has led to internally designed and fabricated gallium arsenide avalanche transit time oscillators and amplifiers. The microwave performance characteristics of these devices have set the state-of-the-art in terms of DC to rf efficiency and amplifier noise figure and has resulted in component application for military systems. Gallium arsenide devices are presently being tested and evaluated in several Army systems. These systems include a Ku-band local oscillator for a portable battlefield radar; an X-band transmitter for a digital communications system; a Ku-band velocity sensor for air cushion vehicles; a pump for a traveling wave tube in a classified coherent doppler system. Details of the results of these tests are discussed along with several other proposed Army applications. Author (TAB)

N70-40680# Signal Analysis Industries Corp., Hauppauge, N.Y.
ADVANCED DIGITAL PROCESSING TECHNIQUES Final Report
Ira M. Langenthal and Sankaran Gowrinathan Griffiss AF, N.Y. RADC May 1970 112 p refs
(Contract F30602-69-C-0119)
(AD-708736; RADC-TR-70-75) Avail: NTIS CSCL 9/5

The objective of the study program was to explore several digital processing areas and investigate the salient problems associated with each. These areas under consideration included digital matched filtering, digital bandpass filtering, lowpass sampling and rapid processing. The nature of the problem of digitally filtering or extracting narrowband information from a broadband signal is described and three approaches (sampling rate decimation, block delay, staggered sampling) are discussed and illustrated with examples and computer simulations. In order to perform the numerical processing (digital filtering) rapidly, the sequence of arithmatic operations is exploited for all symmetries with specific consideration given to a reordering technique, and coefficient normalization. Two procedures are described for synthesizing filter characteristics in the frequency domain but with the processing accomplished in the time domain. The first matches frequency characteristics (magnitude and phase) of a recursive digital filter at a selectable number of points, the second is a recursive formulation of the Fast Fourier transforms algorithm. TAB

N70-40749 National Lending Library for Science and Technology, Boston Spa (England).
CARBON BRUSHES FOR MACHINES WITH COMMUTATORS [KOHLEBUERSTEN FUER MASCHINEN MIT KOMMUTATOREN]
Karl Woda 8 Jun. 1970 30 p Transl. into ENGLISH from Elektrotech. Maschinenbau, v. 87, Jan. 1970 p 36-47 In ENGLISH and GERMAN
(NLL-EE-Trans-1917-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

Carbon brushes for use with dc motors and traction motors were examined with the aid of microphotographs. Sections of the brushes were finished off with diamond dust for the test run and subsequently observed under the microscope. The impregnation (finishing treatment) improves the strength of the brushes, but impairs commutation to a minor degree. It was concluded that a high degree of elasticity of the brush wearing surface is achieved by a loose structure. Other features to be considered for good commutation are material composition, grain size, adhesion, and behavior under pulse operation and no-load running. The brush containing graphite has the necessary low lubricating properties and elasticity and consequently always provides the necessary contact. E.M.C.

N70-40835# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
DIGITAL SYNTHESIS OF NONLINEAR FILTERS Interim Report
R. S. Bucy and K. D. Senne (OAR) Jul. 1970 26 p refs
(Grant AF-AFOSR-1244-67)
(AD-708983; AFOSR 70-1878TR) Avail: NTIS CSCL 9/5

The paper presents a technique for constructing the optimal nonlinear filter using a digital computer. The viewpoint differs fundamentally from almost all previous work in that the state of the nonlinear estimator, the conditional density of the signal given the observations, is represented as a set of point masses on a moving grid. Although the method leads to very accurate realizations of optimal nonlinear filters, there is an inherent drawback in that on exponential dependency of computation time upon dimension rapidly causes the proposed method to become computationally intentable as the dimension increases. This paper describes the methods in detail and indicate how they apply to a particular problem of a passive receiver design. For the particular problem, a Monte Carlo error analysis shows that the optimal filter achieves an order of magnitude mean-square error improvement over the extended Kalman-Bucy filter and at least two orders of magnitude improvement over the least squares filter. Finally a discussion of the implications of these studies on the design of digital machines for filtering purposes is presented. Author (TAB)

N70-40894# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DYNAMIC SOLUTIONS FOR SINGLE AND COUPLED MICROSTRIP LINES
Edgar J. Denlinger 19 Nov. 1969 77 p refs
(Contract AF 19(628)-5167)
(AD-708720; TR-470; ESD-TR-69-388) Avail: NTIS CSCL 20/3

The investigation presents theoretical and experimental results of single and coupled microstrip propagation on both a pure dielectric and a ferrite substrate. The theory enables one to obtain the frequency dependence of phase velocity and characteristic impedance and also to obtain the electromagnetic field quantitites around the microstrip line. It utilizes a Fourier transform method in which the hybrid mode solutions for a fictitious surface current at the substrate-air interface are summed in such a way as to represent the fields caused by a current distribution that is finite only over the region occupied by the conducting strip and is assumed equal to that for the static case. The theory for the magnetized ferrite microstrip takes into account both the diagonal and off-diagonal components of the substrates permeability tensor. Excellent agreement is obtained between experimental and theoretical results for single microstrip lines on both ceramic and demagnetized ferrite substrates. The coupled microstrip theory is applied to two commonly used microwave integrated circuit devices, the directional coupler and the meander-line phase shifter. Author (TAB)

N70-40985# Microwave Associates, Inc., Burlington, Mass.
STUDY OF CYCLOTRON AND SYNCHRONOUS WAVE DEVICES Interim Report, 1 Jun. 1969-1 Apr. 1970
S. F. Paik Jul. 1970 34 p refs
(Contract DAAB07-68-C-0398)
(AD-709611; ECOM-0398-4; IR-4) Avail: NTIS CSCL 9/1

The theory of transverse-wave interactions is reviewed, and theoretical expressions for the gain, optimum efficiency and power output are presented to show design constraints for high-power, high-efficiency tubes. Numerical results of a calculation of the nonlinear behavior of synchronous-wave TWT are presented to show its saturation characteristics. An experimental low-power tube operating in the 500-1000 MHz band was constructed to test various theoretical predictions. The measured axial energy spread induced by the RF interaction and the power saturation characteristics are both in good agreement with the theory. Author (TAB)

N70-40986# Hughes Aircraft Co., Torrance, Calif. Electron Dynamics Div.
DEVELOPMENT OF TRANSMITTER TUBE FOR TROPOSCATTER APPLICATIONS Final Report, 1 Jul. 1968 - 21 Jan. 1970
Arthur L. Rousseau Jun. 1970 75 p refs
(Contract DAAB07-68-C-0477)
(AD-709812; W-2860; ECOM-0477-F; FR-3) Avail: NTIS CSCL 17/2

The program objectives were to determine the design criteria for a highly efficient (50% overall efficiency including focusing and cooling power), 10 kW CW traveling-wave amplifier at C-band and to construct, test and deliver two (2) advanced exploratory development models of the device. This amplifier was to have 11 dB of gain to boost the output power of existing 1 kW troposcatter systems using readily available power generators. Techniques to improve the efficiency by reducing the power necessary to cool the device were an integral part of the program. The tube employs a coupled cavity interaction circuit with a solenoid focused, semi-confined flow electron beam. Improvement in basic tube efficiency is accomplished by voltage jump and phase velocity tapering combined with collector depression. Cooling efficiency is improved by utilizing vapor phase (nucleate boiling) cooling, which eliminates the need for a coolant pump. During the program, the feasibility model tube, designed on a previous program, was tested and two advanced model tubes were designed, constructed and tested. For all of these tubes, excellent agreement with theoretical calculations was obtained. Interaction efficiencies of up to 60% with collector depression and over 50% or greater efficiency, including solenoid and cooling power, was obtained across the frequency band of 4.4 to 5.0 GHz. Author (TAB)

N70-41061# Rensselaer Polytechnic Inst., Troy, N.Y.
PHYSICAL BEHAVIOR OF HIGH FIELD DEVICES Final Report, 28 Apr. 1967 - 27 Apr. 1970
Sorab K. Ghandhi 27 Apr. 1970 7 p
(Contract DAHC04-67-C-0053)
(AD-708899; AROD-6883-5-E) Avail: NTIS CSCL 9/1

Research was aimed at developing a theory of operation for the junction gate, field effect transistor (FET) in the pinched mode, i.e., in its saturated region. All existing theories for this device deal with the region prior to pinch off; interestingly, nearly all FET applications require operation beyond pinch off. Thus, the need for a more complete theory was self-evident. Final programs were extended to the studying of the physical behavior of high field devices. Specifically, research was conducted in the study of the photo-response of NnuN structures under high field conditions. Author (TAB)

N70-41102# Technische Univ., Berlin (West Germany).
SUBSTITUTION OF SILICON IN TRANSFORMER PLATES FOR ALUMINUM, VANADIUM, TITANIUM, AND ZINC [ERSATZ VON SILIZIUM IN TRANSFORMATORENBLECHEN DURCH ALUMUNIUM, VANADIUM, TITAN UND ZINN]
Klaus Pawlek (Ph.D. Thesis) 1968 81 p refs In GERMAN
Avail: NTIS

Improvements in the electrical properties of transformers by substitution of silicon for previously used aluminum, vanadium, titanium, and zinc plates are described. Transl. by P.N.F.

N70-41103# Technische Univ., Berlin (West Germany).
A THYRISTOR BALLAST RESISTANCE [EIN THYRISTORGESCHALTETER BALLASTWIDERSTAND]
Joachim Bangel (Ph.D. Thesis) 1968 103 p refs In GERMAN
Avail: NTIS

The electrical properties of circuits with thyristor ballast resistors are presented. Mathematical models, circuit diagrams, and graphs are provided. Transl. by P.N.F.

N70-41230# Naval Postgraduate School, Monterey, Calif.
DELTA MODULATION INCORPORATING INTEGRATED CIRCUITS: A FEASIBLE STUDY
William Burns Waff (M.S. Thesis) Dec. 1969 55 p refs
(AD-709404) Avail: NTIS CSCL 9/5

Pulse-modulation and integrated circuits, respectively, are the most recent major advances in the communications field and in electronic devices. The evolutionary development of one pulse-modulation technique, Delta Modulation, is examined in this thesis to determine the feasibility of extending its evolution to the inclusion of integrated circuits in its design. An experimental circuit, demonstrating this feasibility, is described and evaluated. Author (TAB)

N70-41294# Naval Ship Missile Systems Engineering Station, Port Hueneme, Calif.
THE INTEGRATOR PREDICTOR, A DIGITAL DRIVE SMOOTHING TECHNIQUE
30 Aug. 1969 25 p
(AD-709402; NSMSES-TR-98) Avail: NTIS CSCL 9/5

The report documents results of tests conducted by the Missile Engineering Station to demonstrate feasibility of smoothly driving the Guided Missile Launching System (GMLS) Mk 13 through use of a digital drive converter similar to Raytheon Company's Analog Interface Device (AID). During the tests, a simulated digital drive signal representative of the AID output was recorded before and after filtering by an integrator predictor type smoothing circuit. The filtered output signal proved largely free of digital-noise characteristics evident in the unfiltered signal. From detailed analyses of test data, it was concluded that the smoothing circuits employed were effective for the purpose intended. Author (TAB)

N70-41300* # Washington Univ., Seattle. Dept. of Electrical Engineering.
THERMAL FEEDBACK IN Si JFETs OPERATING AT LOW TEMPERATURES
M. J. Churchill and P. O. Lauritzen [1969] 10 p refs
(Grant NGR-28-002-078)
(NASA-CR-113934) Avail: NTIS CSCL 09A

The thermal feedback modifies the dc and ac characteristics of junction field effect transistors operating at temperatures where carrier freeze out occurs. Data for common source operation are analyzed using the thermal feedback theory of Mueller. Author

N70-41322* # Tufts Univ., Medford, Mass.
STUDY OF VARIABLE THERMAL IMPEDANCE DEVICES
John H. Sununu May 1970 32 p
(Contract NAS12-2128)
(NASA-CR-113873) Avail: NTIS CSCL 09E

A study and experimental evaluation of a variable thermal impedance device (VTI), as applicable to inertial sensor subassemblies, was conducted. In particular, it involved obtaining test data on an existing VTI and other representative devices. The basic concept of the existing VTI involves the variation of the cross sectional area of the heat path between the source and sink. The experimental effort reported determined the extremes of the range of thermal impedances obtainable with this device, the effect of key parameters such as heat load and sink temperature on the thermal impedance, and the dynamic capability of the device to respond to rapid variations in environmental conditions. In addition to evaluation of the roller VTI, tests were conducted to determine the extreme range of thermal impedances obtainable from a simple system consisting of a pair of liquid cold plates and a pump. In both cases the data obtained were correlated to the analytical evaluation of system performance. Author

N70-41354# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.
A CONTRIBUTION TO THE DYNAMIC BEHAVIOR OF

FREQUENCY CONTROLLED ASYNCHRONOUS MACHINES [EIN BEITRAG ZUM DYNAMISCHEN VERHALTEN DER FREQUENZGESTEUERTEN ASYNCHRONMASCHINE]

Dietrich Naunin (Ph.D. Thesis) 1968 121 p refs In GERMAN
Avail: NTIS

Basic equations for the dynamic behavior of various asynchronous machines are developed and represented in matrix and space vector formulas as well as in structural descriptions. Analyses of several dynamic structural thresholds show that machine behavior and nonlinear magnetization were mainly determined by driver rotation frequencies. Stationary thresholds are calculated and effects on the dynamic behavior for turing optimization are discussed. Proposed is a simple regulating circuit consisting of threshold lines for the optimal realization of turing moments and turing numbers at various control functions. Transl. by G.G.

N70-41461*# Rice Univ., Houston, Tex. Dept. of Space Science.
ELECTRIC FIELD METER INVESTIGATION Final Report, 23 Feb. 1968 - 31 Jul. 1970

H. R. Anderson and G. M. Burton Jul. 1970 92 p refs
(Contract NAS9-7738)
(NASA-CR-108651) Avail: NTIS CSCL 09E

A field meter was developed for the ALSEP experiment package based on the deflection of an electron beam. The test facility and various electron gun and cathode configurations are described. The feasibility of electron beam measurement of an electric field was demonstrated to a resolution of + or - 0.01 volts/meter and an accuracy of 0.1 percent. A prototype electron gun was produced that is fully adequate (with the exception of size and weight) to perform in a flight system. An instrumental prototype was designed to reduce the size and weight. A cathode in the model electron gun will withstand at least one exposure to atmosphere after first activation and deliver an adequate beam at the low power levels required for the ALSEP package. E.C.

N70-41557# Naval Research Lab., Washington, D.C.
A REVIEW OF MICROWAVE SWITCHING SCHEMES AND VARIABLE POWER DIVISION NETWORKS USING PHASE SHIFTERS Interim Report

C. W. Young, Jr. 23 Jun. 1970 29 p
(AD-709442; NRL-7082) Avail: NTIS CSCL 9/5

A mathematical study is made of three basic configurations for steering microwave power by controlling the phase of multiple signals obtained from a single input. The effect of phase errors, coupling errors of hybrid couplers, and component losses on isolation of switches and accuracy of power dividers is determined. Author (TAB)

N70-41600# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
TEMPERATURE STABILITY OF FERRITE SUBSTRATES IN MICROWAVE INTEGRATED CIRCUITS

Isidore Bady Jul. 1970 21 p refs
(AD-709597; ECOM-3313) Avail: NTIS CSCL 9/5

With the increasing use of ferrites in microwave integrated circuits, it becomes important to determine the temperature stability of the effective values of dieelectric constant and unmagnetized permeability of ferrites in this application. This paper reports the results of such measurements on several ferrites. The test samples were slabs 2 x 0.5 x 0.032 inches. In order to provide a basis for understanding the intrinsic properties of the ferrites, the slabs were tested first by completely copper plating the sample except for an iris at eeach end. The resonant frequencies of the samples were measured at room temperature and at an elevated temperature, first without a bias field, then with a bias field. From the measurements, data was obtained on the intrinsic dielectric constant and unmagnetized permeability, and their temperature coefficients. Formulas are given to calculate the effective values from the intrinsic values. The original plating was then removed and the sample replated as a microstrip line. The magnetic filling factor was obtained from measurements on the microstrip line. Author (TAB)

N70-41655* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PULSE COUNTING CIRCUIT WHICH SIMULTANEOUSLY INDICATES THE OCCURRENCE OF THE nTH PULSE Patent

Jon Richard Rehage, inventor (to NASA) Issued 22 Nov. 1966 (Filed 12 Mar. 1963) 6 p Cl. 324-113
(NASA-Case-XMF-00906; US-Patent-3,287,640;
US-Patent-Appl-SN-264731) Avail: US Patent Office CSCL 09E

A system for indicating each pulse of a pulse train and a signal denoting the nth pulse is described. The input signal is fed to a variable impedence, such as a squaring circuit, which changes the signal rate between fixed amplitude limits. The variable impedance is connected in series with a recording galvanometer. The signal actuates the galvanometer as square or rectangular current variations occur. The resulting voltage variations are coupled to a resistance-capacitance differentiation circuit which provides a spike pulse output to an integrating circuit. This circuit provides a narrow width voltage output proportional in amplitude to the number of input pulses. The output is applied to a unijunction transistor which abruptly changes impedance when fed a voltage of a certain level. The current changes correspondingly to the square wave and abrupt impedance variations to produce a dual output. The dual output indicates each cycle of input signal and also when a predetermined number of cycles have occurred. N.E.N.

N70-41675* Westinghouse Electric Corp., Pittsburgh, Pa.
LINEAR SAWTOOTH VOLTAGE-WAVE GENERATOR EMPLOYING TRANSISTOR TIMING CIRCUIT HAVING CAPACITOR-ZENER DIODE COMBINATION FEEDBACK Patent

Elberson D. Green and Martin G. Woolfson, inventors (to NASA) Issued 31 Jan. 1967 (Filed 24 Feb. 1964) 4 p Cl. 307-88.5
Sponsored by NASA
(NASA-Case-XMS-01315; US-Patent-3,302,040;
US-Patent-Appl-SN-347101) Avail: US Patent Office CSCL 09E

A sweep circuit, utilizing a pair of feedback loops and an input terminal for applying a source of pulses to the base of a switching transistor, is described. The first loop contains a zener diode which maintains a relatively constant charging current. The second loop contains a capacitor which allows the zener diode current to remain relatively constant during the generation of the sweep voltage and allows a charging capacitor to charge to a relatively high voltage level. Either an n-p-n or p-n-p transistor may be used. N.E.N.

N70-41708# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Dept.
EVALUATING THE CONFIDENCE INTERVAL FOR THE RELIABILITY OF GENERAL MULTICOMPONENT SYSTEMS

Larry J. Massa Jun. 1970 75 p refs
(AD-709430; QETR-5) Avail: NTIS CSCL 14/4

The combining of components (e.g., diodes, transistors, semiconductors, etc.) into a complex system has presented the problem of estimating the reliability of the entire system with some specified degree of confidence. Various exact and approximate methods exist for very special cases. This paper, however, reviews some of the current simulation procedures and presents a method for solving the more difficult general problem. Three forms of data input are considered. (1) Point estimates of the parameters of the assumed underlying distributions for the component failures may be made from sample data (examples are given for the binomial and exponential distributions). (2) The lower or upper reliability limit (with appropriate confidence level) may be specified for each component with no information about the sample results. (3) A subjective assessment of a prior distribution of component failure times

may be given along with (1) above. A Monte Carlo simulation technique, can take any combination of these three types of data input and compute an estimate of the reliability of a simple or complex system with a relatively small error. Author (TAB)

N70-41717* Westinghouse Electric Corp., Pittsburgh, Pa.
THERMAL CONDUCTIVE CONNECTION AND METHOD OF MAKING SAME Patent
Paul E. Woodie, Paul J. Kiefer, Jr., Charles W. Wyble, and Charles A. Herper, inventors (to NASA) Issued 31 Jan. 1967 (Filed 12 Mar. 1965) 4 p Cl. 165-1 Sponsored by NASA
(NASA-Case-XMS-02087; US-Patent-3,301,315; US-Patent-Appl-SN-439489) Avail: US Patent Office CSCL 09C

A description is presented of a thermal conductive, electrically insulated cleavable adhesive connection between an electronic module and a heat sink used for cooling the module. The connection is formed by coating the heat sink with a layer of plastic such as Teflon, applying thermal conductive grease with good high vacuum and thermal properties, and bonding the heat producing body to the grease with a layer of thermal conductive adhesive. The grease forms a cleavage plane which allows easy separation when desired. An example of adhesive is given as 190 parts by weight of 325 mesh silica, 34 parts by weight of epoxy resin, and 100 parts by weight of polyamide resin catalyst. N.E.N.

N70-41765# Army Electronics Command, Fort Monmouth, N.J.
DESIGN CRITERIA FOR FLUX-SHIELD VARIABLE INDUCTORS
Abraham Rand Jun. 1970 24 p refs
(AD-709595; ECOM-3301) Avail: NTIS CSCL 9/1

Design equations are developed for three configurations of Flux-Shield Inductors. At cryogenic temperatures where conductors support zero magnetic flux, it is shown that there is an optimum shape factor of 2.2 for the ratio of diameter to length which yields a minimum quantity of superconductive shield material for any given inductor tuning ratio. Comparing shield volume of the two-coil-one-shield configuration and the three-coil-two-shield configuration against the one-coil-one-shield configuration gives relative volume factors for each, as follows: V = 1 for the one-coil, V = 0.25 for the two-coil, and V = 0.16 for the three-coil. Experimental verification at room temperature shows discrepancies with predictions of less than 5% for coils which have small turn-to-turn spacing. Author (TAB)

N70-41783# Kentucky Univ., Lexington. Dept. of Chemistry.
DROP-TIME CONTROLLER AND SAMPLE-AND-HOLD CIRCUIT FOR USE WITH DROPPING MERCURY ELECTRODES
D. Britz, F. M. Hawkridge, and H. H. Bauer Mar. 1970 17 p ref
(Contract DAAB07-69-C-0366; Proj. Themis)
(AD-708883; THEMIS-UK-RR-10) Avail: NTIS CSCL 7/4

Circuits are described for sample-and-hold measurements at a dropping mercury electrode. The unit is intended for use with the previously described a.c.-d.c. polarograph (AD-708 881). Operation of the instrument in the sample-and-hold mode has inherent advantages, as does the use of a controlled drop-time of the electrode. In addition, automation of data-gathering and analysis will be readily achieved by taking the outputs from the sample-and-hold circuitry directly to an on-line computer. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N70-40422 Rice Univ., Houston, Tex.
DESIGN OF MINIMUM SENSITIVITY CONTROL SYSTEMS
Vidojko Vladimir Ciric (Ph.D. Thesis) 1969 150 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-19275

The response of linear systems with optimum compensators which do not require measurement of all state variables may be very sensitive to plant parameter variations. It is shown that if these designs contain free parameters, the effect of variations of plant parameters on the performance index can be reduced significantly. The results are general and include high order compensators, the case of arbitrary initial conditions and minimax design. The minimax designed system is optimal and insensitive to plant parameter variations for all initial conditions. The necessary and sufficient conditions for the existence and uniqueness of the solution to the above problems are stated and proved. A new controllability concept in sensitivity design of an optimal control system is introduced, and the conditions for existence and uniqueness are related to this controllability concept. Examples of fourth, fifth, and sixth order linear system designs are presented. Dissert. Abstr.

N70-40510 University of Southern Calif., Los Angeles.
ANALYSIS AND SYNTHESIS OF MATCHED FILTERS WITH DISTRIBUTED-PARAMETER NETWORKS
Ali Akbar Beihaghi (Ph.D. Thesis) 1969 138 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-19359

The main objective is to analyze and synthesize distributed-parameter matched filters, that is, linear filters formed from distributed-parameter networks which supply at the output a maximum signal-to-noise ratio at some instant of time. The filters are studied both in the time and frequency domain. The general RC and LC distributed matched filters are studied in greater detail. An attempt is made to classify signals that can be matched by the general RC and LC distributed matched filters operating in additive noise. Synthesis of RC and LC distributed matched filters was investigated. In the frequency domain, the conditions are given for transcendental functions to be the open-circuit voltage transfer functions of general RC and LC distributed matched filters. Similarly, in the time domain, conditions are given for a time function to be the open-circuit impulse response of a general RC or LC distributed matched filter. Dissert. Abstr.

N70-40691# Stanford Univ., Calif. Information Systems Lab.
CASCADE SCATTERING MATRIX SYNTHESIS
Patrick M. Dewilde Jun. 1970 145 p refs
(Contract N00014-67-A-0112-0044)
(AD-709068; TR-6560-21; SU-SEL-70-020) Avail: NTIS CSCL 9/5

The theory developed in this work concentrates on a problem in Multiport Network Theory, namely the synthesis of a finite scattering operator. Given a scattering matrix S or a transfer scattering matrix Sigma sub (21) between prescribed terminals, it is asked to determine an algorithm in order to realize networks which implement the given function. Author (TAB)

N70-40730 National Lending Library for Science and Technology, Boston Spa (England).
AN INTRINSICALLY SAFE CONTACTLESS CONTROL SYSTEM
W. Gehl 8 Jun. 1970 15 p Transl. into ENGLISH from Polytech. Tijdschr. (Heemstede), v. 23, no. 14, 1968 p 492–496
(NLL-LB/9/2871-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Intrinsically safe circuit properties for safeguarding explosion hazards are discussed as well as the disadvantages of mechanical contacts. The basic components of a contactless control system are summarized including the detector and amplifier and their designs. The limit frequencies of mechanical contact and contactless systems

are considered. Applications of contactless systems are examined including remotely controlled measurement, safeguarding direction of rotation, and a digital to analog converter. System diagrams are given. J.M.

N70-40752# Louisiana State Univ., Baton Rouge. Coll. of Engineering.
THE SLOW SET POINT CONTROL ALGORITHM
Alberto A. Rovira, Paul W. Murrill, and Cecil L. Smith Feb. 1970 17 p refs
(Contract F44620-68-C-0021)
(AD-708520; THEMIS-LSU-T-TR-34; AFOSR-70-1803TR) Avail: NTIS CSCL 12/1

The difference existing between the controller tuning parameters obtained by optimizing the response to disturbances and the parameters obtained by optimizing the response to set point changes has been shown in a previous paper. In a proportional plus integral (PI) algorithm, the proportional action may be applied to the error signal or to the feedback variable. Both variations respond in the same manner to disturbances, but they respond differently to changes in set point. In this paper the responses of both algorithms to the different types of inputs are studied. Author (TAB)

N70-40827# Joint Publications Research Service, Washington, D.C.
MICROMINIATURIZATION IN RADIO ELECTRONICS
Todor Slavov *In its* Transl. on Eastern Europe Sci. Affairs, no. 130 9 Sep. 1970 p 4–5 Transl. into ENGLISH from Tekhn. Delo (Sofia), 1 Aug. 1970 p 1, 5 (See N70-40826 23-34)
Avail: NTIS

Metal oxide semiconductor integrated circuits for computer equipment were developed. Thin film circuits for passive components, integrated modular circuits, and microelectronic hybrid circuits were produced. A complex experimental production line for silicon planar epitaxial transistors was initiated. J.A.M.

N70-40934*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
A BIBLIOGRAPHICAL SURVEY OF LARGE-SCALE SYSTEMS
William R. Corliss 15 Jan. 1970 50 p refs
(NASA-TM-X-66335) Avail: NTIS CSCL 09C

A limited, partly annotated bibliography is presented on the subject of large-scale system control. Approximately 400 references are divided into thirteen application areas, such as large societal systems and large communication systems. A first-author index is provided. Author

N70-41036*# Arizona Univ., Tucson. Dept. of Electrical Engineering.
ANALYSIS AND SYNTHESIS OF DISTRIBUTED-LUMPED-ACTIVE NETWORKS BY DIGITAL COMPUTER Semiannual Report, 1 Sep. 1969–28 Feb. 1970
L. P. Huelsman Feb. 1970 8 p refs
(Grant NGL-03-02-136)
(NASA-CR-113867) Avail: NTIS CSCL 09C

An investigation of the ways in which a modern digital computational facility may be used in the analysis and synthesis of networks whose elements are distributed, lumped, and active (DLA) is discussed. The modeling of two or three layered, distributed RC networks with arbitrary terminal configurations imposed on the resistive layers, the synthesizing of DLA networks by the use of optimization techniques which avoid many of the problems of nonconvergence frequently encountered in the application of such techniques, and the development of a general synthesis capability permitting the application of complex optimization techniques to arbitrary DLA configurations are emphasized. Author

N70-41055# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANICAL AND POWER EQUIPMENT OF AIRPORTS
A. A. Bromberg et al 27 May 1970 432 p refs Transl. into ENGLISH of the book "Mekhanicheskoe i Energeticheskoe Oboru. Oborudovanie Aeroportov" Moscow, 1968 p 1–336
(AD-709693; FTD-MT-24-55-70) Avail: NTIS CSCL 1/5

Methods of selecting, constructing, and operating airport mechanical and power supply equipment are discussed. TAB

N70-41133*# Bellcomm., Inc., Washington, D.C.
STABILITY ANALYSIS OF LUMPED-DISTRIBUTED FEEDBACK SYSTEMS VIA OPEN-LOOP NYQUIST PLOTS
G. C. Reis 22 Sep. 1970 40 p refs
(Contract NASw-417)
(NASA-CR-113815; TM-70-1033-5) Avail: NTIS CSCL 09C

Conditions under which the stability of distributed systems can be determined by Nyquist's criterion over a finite band of frequencies are derived, and these results are applied to a simple system related to Saturn 5 pogo stability. Author

N70-41184*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ADAPTIVE STOCHASTIC CONTROL FOR LINEAR SYSTEMS. PART 1: SOLUTION METHOD
Edison Tse (Systems Control, Inc.) and Michael Athans 1 May 1970 36 p refs
(Grants NGL-22-009-124; AF-AFOSR-1724-69)
(NASA-CR-113825; AD-706935; AFOSR-70-1511TR-Pt-1) Avail: NTIS CSCL 12A

The problem considered in this two-part paper deals with the control of linear, discrete-time, stochastic systems with unknown (possibly time-varying and random) gain parameters. The philosophy of control is based on the use of an open-loop-feedback-optimal (O.L.F.O.) control using a quadratic index of performance. In Part I it is shown that the O.L.F.O. system consists of (1) an identifier that estimates the system state variables and gain parameters, and (2) by a controller described by an adaptive gain and correction term. Several qualitative properties of the overall system are obtained from an interpretation of the equations. Part II deals with the asymptotic properties of the O.L.F.O. adaptive system and with simulation results dealing with the control of stable and unstable third order plants. Comparisons are carried out with the optimal system when the parameters are known. In addition, the simulation results are interpreted in the context of the qualitative conclusions reached in Part I. Author (TAB)

N70-41263# Kentucky Univ., Lexington. Dept. of Chemistry.
A STUDY OF POLAROGRAPHIC MAXIMA EMPLOYING THREE-ELECTRODE CIRCUITRY
F. M. Hawkridge, T. W. Holt, and H. H. Bauer Jun. 1970 23 p refs
(Contract DAAB07-69-C-0366; Proj. Themis)
(AD-709641; THEMIS-UK-RR-13) Avail: NTIS CSCL 7/4

Characteristics of polarographic maxima, studied by means of three-electrode circuitry, are described. There are major differences as compared with results obtained with two-electrode circuits; the literature on this subject has hitherto been restricted to studies in the latter category. Author (TAB)

N70-41262# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Electrophysics.
MODERN CLASSICAL MULTIVARIABLE FEEDBACK CONTROL THEORY, PART 1
Dante C. Youla Jun. 1970 32 p refs
(Contract F30602-69-C-0053)
(AD-709212; PIBEP-70-054; Pt-1RADC-TR-70-98-Pt-1) Avail: NTIS CSCL 12/1

The report establishes rigorous stability criteria in terms of transfer matrices and in addition undertakes a careful and critical examination of the concepts of complete controllability and observability as applied to the closed loop. In particular it is emphasized that the latter properties are neither necessary nor desirable attributes of a practical multivariable feedback system. Author (TAB)

N70-41288# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.

INVESTIGATING THE PROPERTIES OF LINEAR TIME-INVARIANT DISCRETE SYSTEMS WITH APPLICATION TO DETERMINING SUBOPTIMAL RESTRICTED CONTROL SEQUENCES [UNTERSUCHUNGEN VON EIGENSCHAFTEN LINEARER ZEITINVARIANTER DISKRETER SYSTEME MIT ANWENDUNG AUF DIE BESTIMMUNG VON SUBOPTIMALEN BESCHRAENKTEN STEUERFOLGEN]

Irmfried Hartmann (Ph.D. Thesis) 1968 99 p refs In GERMAN
Avail: NTIS

The determination of sub-time-optimal amplitude limited control sequences in linear time-invariant discrete systems, which can be partially or completely described by a given vector difference equation of nth order, is considered. A sub-time-optimal technique is proposed in which the limited control sequence of state x beyond a given domain U(Q) is transmitted in no more than (n + m sub opt) scanning steps in the 0 state, if optimal m is the number of time-optimal control elements for this state. The given technique is restricted to various real eigenvalues of the system matrix phi. Transl. by R.B.

N70-41298*# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.

DESIGNERS MANUAL FOR COMPUTER-AIDED DESIGN OF CONTROL CIRCUITS Final Technical Report

S. D. Bedrosian and D. I. Howe 15 Jun. 1970 344 p refs
(Contract NAS12-2137)
(NASA-CR-113930) Avail: NTIS CSCL 09C

This manual describes the necessary preliminary electric circuit modeling and methods of computer analysis using the NASAP digital computer program to aid in the design of control circuits used in aerospace systems. The scope of design treated is limited to single-input single-output linear time invariant control systems that can be described by rational transfer functions. Two different approaches can be followed in the design of such linear time invariant feedback control systems. In one case the designer seeks compensators for a given plant to satisfy the over-all system requirements. This approach generally involves cut and try and the well known conventional design techniques such as the Bode and Nyquist plots and use of the root locus. In the other case, the designer starts by obtaining the over-all transfer function from the given plant and the specifications. He is then in a position to determine the required compensators. The second of these two approaches seems more amenable to computer-aided design of control circuits using the NASAP program. Author

N70-41308# Technische Univ., Berlin (West Germany).

CONTRIBUTION TO THE SYNCHRONIZATION THEORY FOR ELECTRICAL OSCILLATORS [BEITRAG ZUR THEORIE DER SYNCHRONISATION ELEKTRISCHER OSZILLATOREN]

Juergen Feldmann (Ph.D. Thesis) 1968 111 p refs In GERMAN
Avail: NTIS

The effects of synchronized vibrations on oscillator behavior are considered since the frequency of a synchronized oscillator depends on its relationship with the synchronizing number of vibrations and can be regulated through forced locking or tracking synchronization. In the first case, the synchronizing amplitude directs oscillator network and forces the oscillator to conform; tracking synchronization compares oscillator phase range with that of the synchronizing vibration in a phase detector and forms a new control amplitude for oscillator frequency and phase. Differential equations describing oscillator behavior are solved by graphs as well as by computer calculations. The dynamic threshold for a synchronized oscillator is depicted by the current-voltage level and used to calculate the dependency of oscillator frequency on synchronized vibrations. Transl. by G.G.

N70-41346# Technische Univ., Berlin (West Germany).

THE INFLUENCE OF ATMOSPHERIC WATER VAPOR ON ELECTRICAL DISCHARGES IN NONHOMOGENEOUS FIELDS DUE TO ALTERNATING CURRENT [UEBER DEN EINFLUSS DES WASSERDAMPFGEHALTES DER LUFT AUF DEN ELEKTRISCHEN DURCHSCHLAG IM INHOMOGENEN FELD BEI WECHSELSPANNUNG]

Werner Baucke (Ph.D. Thesis) 1968 111 p refs In GERMAN
Avail: NTIS

The effects of atmospheric moisture on electric discharges in a nonhomogeneous field by alternating voltages are discussed. The negative and positive pre-discharge tracks are examined for various conditions of ambient humidity. The results of the research are presented in graphs, tables, and photographs of oscillograph traces. The test equipment and circuit diagrams are described. Transl. by P.N.F.

N70-41353# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.

STUDIES ON STATIONARY AND DYNAMIC BEHAVIOR OF EMITTER-COUPLED SWITCHING CIRCUITS [UNTERSUCHUNG DES STATIONAEREN UND DYNAMISCHEN VERHALTENS EMITTERGEKOPPELTER SCHALTKREISE]

Hans Konrad Schmidt (Ph.D. Thesis) 3 Jan. 1968 280 p refs In GERMAN
Avail: NTIS

A computer simulation program for calculating systems of nonlinear differential equations is used to design emitter-coupled switching circuits with emitter contacts at entrance and exit. Approximation methods for calculating initial capacity, delay times, and error correction are described and their accuracy is demonstrated on various example calculations. Transl. by G.G.

N70-41356# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.

DUAL ADAPTIVE SEQUENTIAL CONTROL FOR ARBITRARILY ORDERED SYSTEMS WITH UNKNOWN PARAMETERS [DUALE ADAPTIVE FOLGEREGELUNG FUER SYSTEME BELIEBIGER ORDNUNG MIT UNBEKANNTEN PARAMETERN]

Manuel de Jesus Mendes (Ph.D. Thesis) 1968 124 p refs In GERMAN
Avail: NTIS

Optimal control of a system with n adaptive impulses is considered by applying the dual control theory. The optimization algorithm that provides for the analysis of time variable systems of higher order is identified and generalized by regression analysis. Approximation of complex control systems by systems of lower order in adaptive control sequences simplifies the calculating algorithm and shortens calculation time. Transl. by G.G.

N70-41357# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.

STRUCTURAL ANALYSIS AND ALGEBRAIC SYNTHESIS OF LINEAR ELEMENTARY CONTROL LOOPS [STRUKTURANALYSE UND ALGEBRAISCHER ENTWURF LINEARER EINFACHREGELKREISE]

Michael Taeschner (Ph.D. Thesis) 1968 130 p refs In GERMAN
Avail: NTIS

Considered are linear dynamic systems that contain a regulation

point, several disturbing values, several initial values, but only one control parameter. A linear control law is formed by using a quadratic classification criterion and the structure of the developed control system is compared with several control system designs. Results are used to discuss necessary specifications in regard to interference values and variable parameter effects. Transl. by G.G.

N70-41449# Los Alamos Scientific Lab., N.Mex.
LARGE-SIGNAL EFFECTS IN THE MULTICAVITY KLYSTRON
Paul J. Tallerico Feb. 1970 14 p refs
(Contract W-7405-ENG-36)
(LA-4389) Avail: NTIS

A confined flow, large signal formulation of the klystron interaction equations is presented and applied to the analysis of the multicavity klystron amplifier. The effects of cavity voltage, cavity phase, drift length, and beam parameters are studied. The two- and three-cavity amplifiers are studied in detail, and several numerical examples of four-cavity klystrons are also given. A significant second harmonic component of velocity modulation is shown to improve the dc to rf conversion efficiency. Two methods of obtaining this modulation are discussed. The large and small signal theories presented here have been used to design a five-cavity klystron that is 50% efficient and that has a controllable power transfer curve. Theoretical and experimental power transfer curves are presented for several 1-1/4 MW klystrons; the calculated output power is between 4 and 10% greater than the experimental values. Author (NSA)

N70-41488# University of Southern Calif., Los Angeles. Frank J. Seiler Research Lab.
DIGITAL SYNTHESIS OF NONLINEAR FILTERS
Richard S. Buch and Kenneth D. Senne Jul. 1970 30 p refs
Submitted for publication
(Grant AF-AFOSR-1244-67)
(AD-709195; SRL-70-0010) Avail: NTIS CSCL 9/5

The existing technique of designing nonlinear estimators based on Taylor series approximations frequently leads to undesirable behavior. The estimation errors, for example, may diverge for any order approximation, and furthermore it is not necessarily true that mean square error performance improves as the order of the series approximation is increased. Thus, it is clear that there is sufficient motivation for reexamining the problems associated with implementing the optimal filter in some practical way on a computer. Examples are discussed of a technique for solving the two basic subproblems associated with optimal discrete-time nonlinear estimation: density storage and Bayes-law computation. For density storage, point mass representation on a floating grid of indices are considered. For Bayes-law computation, an efficient convolution summation is discussed, involving an ellipsoid tracking technique to determine the important points to include in the summation. Author (TAB)

N70-41594# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.
THE NYQUIST CRITERION FOR CONTROL LOOPS WHOSE BEHAVIOR IS DESCRIBED BY LINEAR FUNCTIONAL DIFFERENTIAL EQUATIONS [DAS NYQUIST-KRITERIUM FUER REGELKREISE, DEREN VERHALTEN DURCH LINEARE FUNKTIONAL-DIFFERENTIAL-GLEICHUNGEN BESCHRIEBEN WIRD]
Bernhard Herz (Ph.D. Thesis) 1968 53 p refs In GERMAN
Avail: NTIS

The system of linear functional differential equations, by which the dynamic behavior of the control loop is described, is simulated by a system of linear differential equations with constant real numbers and is based on studies of the absolute stability of control systems. General existence and uniqueness theorems are considered and the definition of stability is given in the sense of Liapunov functions. Special linear systems are derived and their typical equations and functions are developed. It is shown that the whole functions are generally transcendental and previous results on the stability of linear functional differential equations are cited. The geometrical properties of the polar frequency response locus of the frequency range and the functional-theoretical studies of the transformation function are considered. Transl. by R.B.

N70-41742 National Lending Library for Science and Technology, Boston Spa (England).
INTRINSIC SAFETY PROTECTION [DIE SCHUTZART EIGENSICHERHEIT]
G. Vogt Feb. 1970 41 p refs Transl. into ENGLISH from Glueckauf (Essen), v. 104, no. 26, 1968 p 1193–1206
(NLL-SMRE-Trans-5690-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

The ignition limit curves of various circuit breakers were investigated to establish the lowest electrical values at which they produce an ignition. It is shown by comparing the characteristic curves that the material of the switching electrodes significantly affects the ignition process. Other factors such as thermal values, heat of vaporization, and heat of combustion also affect the ignition of explosive mixtures. A method of intrinsic safety protection is discussed in which the electrical energy flowing and stored in circuits is so low that the sparks occurring during interruption and short circuiting are unable to ignite an explosive gas-air mixture. R.B.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N70-40579# Hughes Aircraft Co., Culver City, Calif.
THE ELECTRONIC PROPERTIES INFORMATION CENTER (EPIC) Technical Report, 1 Feb. – 28 Feb. 1970
Sheldon J. Welles May 1970 59 p refs
(Contract F33615-68-C-1225)
(AD-708737; AFML-TR-70-120) Avail: NTIS CSCL 5/2

The Electronic Properties Information Center has expanded its scope to include increased coverage of the optical properties of materials, revised and expanded its indexing system to accommodate this expansion, acquired 10,000 carefully reviewed documents, bringing EPIC holdings to 42,000 items, and delivered to the Air Force a complete index to these holdings. Over 15,000 copies of 38 technically competent publications, prepared during this period, were distributed to EPIC users. The use of the Center has increased dramatically during this period: 2861 requests were received by the Center, an increase of 65 percent over a similar 1966-67 period, and over 1000 individual scientists and engineers currently avail themselves of the Centers services on a regular basis, an increase of 73 percent since January 1968. The EPIC publicity and sales programs, aggressively pursued during this period, and the Centers future plans are reviewed. Author (TAB)

N70-40778# Federal Aviation Administration, Washington, D.C. Aircraft Development Service.
RUNWAY TRACTION
R. C. McGuire *In its* Res. and Develop. Rept. to Ind., Jun. 1969 5 p (See N70-40776 23-02)
Avail: NTIS

The status of the FAA research and development work

on runway friction is presented. The need for an early solution to the improvement of aircraft safety of operations on wet and slippery runways is reiterated. Brief summaries are given of research progress on: (1) runway grooving; (2) friction measurement correlation with aircraft performance; (3) analog computer correlation study of an airplane and its brake and anti-skid systems; and (4) correlation of runway friction measurements with airplane performance by use of decelerometers. A.L.

N70-40901*# Hughes Research Labs., Malibu, Calif.
SOLAR WIND SIMULATION TECHNIQUES Final Report
H. J. King and D. E. Zuccaro Apr. 1970 205 p refs
(Contract NAS2-5585)
(NASA-CR-73443) Avail: NTIS CSCL 14B

The goals were to analyze the techniques for laboratory simulation of the solar wind and to establish an optimized design for such a system. This program was motivated by the fact that laboratory experiments did not appear to duplicate the changes that occurred in the thermal control coatings used on operational spacecraft. This study consists of four major elements: (1) the evaluation of the experimental data of the solar wind, (2) the establishment of a set of requirements for a solar wind simulation system, (3) the evaluation of the techniques and apparatus that could be used to generate the required ion beam, and (4) the design of an optimized solar wind simulation system. This study was limited to the simulation of energetic particulate solar radiation (i.e., protons, alpha particles, highly charged heavy ions, and electrons). Author

N70-41001# Massachusetts Univ., Amherst. School of Engineering.
DEFINING THE FLOW FIELD OF AN OPEN-JET WIND TUNNEL
Donald B. Poole and Duane E. Cromack Jun. 1970 81 p refs
(Contract N00014-68-A-0146-12; Proj. Themis)
(AD-709158; THEMIS-UM-70-3) Avail: NTIS CSCL 14/2

This investigation deals with mapping the velocities at successive cross-sectional planes in the test section of an open-jet wind tunnel. The instrumentation was chosen so that the total uncertainty on the calculated velocity would be less than 1% with a 95% confidence level. The jet was studied using photography and a grid-and-tuft scheme, and it was determined that the same flow characteristics appear at both high and low flow rates. The best probable location for model testing was determined to be 1-1/4 ft. to 2-1/2 ft. away from the exit plane of the tunnel as indicated by the combined pressure measurements and the photographic studies. It was also noted that turbulent mixing occurred between the jet and the still air in the room. The turbulence had a tendency to move in toward the center of the jet at successive planes from the exit plane of the tunnel. The most drastic change in turbulent mixing occurred at a cross-section 3 ft. away from the exist plane. Recommendations for alterations to the facility are made for testing at or near the 3 ft. location. Author (TAB)

N70-41076# Federal Aviation Administration, Washington, D.C.
PAPERS PRESENTED AT STOL PORT PLANNING AND DESIGN CONFERENCE
26 May 1970 100 p refs Conf. held 20 Apr. 1970, Washington, D.C.
(N-5390.3) Avail: NTIS

CONTENTS:

1. STOL CONFERENCE OBJECTIVES C. G. Bowers p 1-6 (See N70-41077 23-11)
2. FORMULATION OF DESIGN CRITERIA R. J. Endres p 7-12 (See N70-41078 23-11)
3. OPERATIONAL EXPERIENCE WITH STOL AIRCRAFT P. Baker and A. Betti p 13-20 (See N70-41079 23-11)
4. STOL RUNWAY LENGTH DETERMINATION G. Buley p 21-30 (See N70-41080 23-11)
5. TERMINAL NAVAIDS AND IFR OPERATIONS G. E. Gibson p 31-40 (See N70-41081 23-11)
6. OBSTRUCTION CLEARANCE SURFACE G. L. Crosby p 41-50 (See N70-41082 23-11)
7. STOL MARKING AND LIGHTING T. J. Williams p 51-56 (See N70-41083 23-11)
8. STOL PORT SAFETY C. Shulten and H. W. Eakins p 57-74 (See N70-41084 23-11)
9. OPERATIONAL RESEARCH RELATED TO STOL PORTS J. C. Staples p 75-80 (See N70-41085 23-11)
10. PLANNING THE STOL AIR TRANSPORT SYSTEM T. McNamara p 81-92 ref (See N70-41086 23-11)
11. FEDERAL ASSISTANCE IN FUNDING STOL PORT DEVELOPMENT L. E. Gutherie p 93-97 (See N70-41087 23-11)

N70-41077# Federal Aviation Administration, Washington, D.C.
STOL CONFERENCE OBJECTIVES
Chester G. Bowers *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 1-6 (See N70-41076 23-11)
Avail: NTIS

Introductory remarks on the objectives of the conference are presented. It is pointed out that the common goal is the improvement of the national air transportation system by the establishment of a STOL air transportation system which supplements and complements the conventional aircraft system. To achieve this goal will require the concurrent development of both the vehicles and the landing facilities. One port design characteristic specifically discussed is that of the FAA suggested runway length of 1500 feet which is considered within the current state of the art. A.L.

N70-41078# Federal Aviation Administration, Washington, D.C.
FORMULATION OF DESIGN CRITERIA
Robert J. Endres *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 7-12 (See N70-41076 23-11)
Avail: NTIS

Rationale being considered by the FAA in the formulation of design and construction standards for the development of STOL ports are discussed. In the establishment of these standards it is necessary to ferret out and determine a balance of the needs between all of the related areas of the air transportation industry, the user, the supplier, and the vehicle with equal emphasis on the effects on the community, environment, and the general public. The optimum criteria developed must be compatible with the already existing complex system. A.L.

N70-41079# Federal Aviation Administration, Washington, D.C.
OPERATIONAL EXPERIENCE WITH STOL AIRCRAFT
Paul Baker and Alder Betti *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 13-20 (See N70-41076 23-11)
Avail: NTIS

Operational tests conducted on aircraft which were candidates for STOL operations indicated that crosswinds, tailwinds, turbulence, and wind shear may be limiting factors on STOL operations, particularly where bi-directional elevated STOLports are concerned. Operational requirements considered necessary for the conduct of safe operations from elevated STOLports are: (1) approach guidance and departure system; (2) containment on elevated port; and (3) aircraft performance. Also being investigated are passenger acceptance, pilot reaction and performance when landing on elevated sites, and wind considerations as they apply to building design and operations. A.L.

N70-41080# Federal Aviation Administration, Washington, D.C.
STOL RUNWAY LENGTH DETERMINATION
George Buley *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 21-30 (See N70-41076 23-11)
Avail: NTIS

Parameters which affect runway length determination for STOL ports are discussed. It is intended that the procedure discussed will establish a common understanding of STOL runway length and how it is derived, particularly for an elevated port. Author

N70-41081# Federal Aviation Administration, Washington, D.C.
TERMINAL NAVAIDS AND IFR OPERATIONS
Gerald E. Gibson *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 31-40 (See N70-41076 23-11)
Avail: NTIS

The policies and philosophies of the FAA concerning the type of navigation aids necessary to permit safe, viable, and economic IFR operations of STOL aircraft in metropolitan and terminal areas are discussed. A specially designed microwave ILS guidance system for STOL operations is described. Acceptance tests are being conducted on the airborne version of the system. A.L.

N70-41082# Federal Aviation Administration, Washington, D.C.
OBSTRUCTION CLEARANCE SURFACE
Gerald L. Crosby *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 41-50 (See N70-41076 23-11)
Avail: NTIS

Prevention of encroachment of construction on the airspace needed for a STOL port is discussed. It is pointed out that local zoning ordinances and Federal regulations that require screening of construction proposals are two means of controlling it. However, both require some kind of standard guide to determine when an obstacle is an obstruction and when an obstruction is a hazard. Methods of determining imaginary surfaces of airspace through which no obstacle shall be permitted to penetrate are discussed. Federal regulation FAR Part 77 already provides protection of airspace, within definite limits, and will be revised as additional operational experience is gained regarding STOL aircraft. A.L.

N70-41083# Federal Aviation Administration, Washington, D.C.
STOL MARKING AND LIGHTING
Thomas J. Williams *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 51-56 (See N70-41076 23-11)
Avail: NTIS

Rapid development of STOL lighting and marking systems has resulted in a configuration having safeguards believed necessary to prevent conventional aircraft from inadvertantly landing on STOL runways. Application of existing hardware to the problem has resulted in adequate performance for STOL aircraft operations but a need exists to improve VASIS for the lower zone near the surface. Further development is also needed for IFR operations as to approach light configuration and hardware characteristics for approach lighting as well as other fixtures used in the threshold, edge, centerline, and end lighting components. Author

N70-41084# Federal Aviation Administration, Washington, D.C.
STOL PORT SAFETY
Carl Shulten and Howard W. Eakins *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 57-74 (See N70-41076 23-11)
Avail: NTIS

The history of the evolution of aircraft arresting systems is briefly reviewed along with some of the energy absorbing systems in use by the military that might be used for STOL port uses. It has been determined that no existing system can be taken off the shelf and used on a STOL port that will meet all the tentative requirements. It is proposed that action be taken with industry to define the future application of arresting systems at STOL ports and develop specifications for the production of a system that will contain STOL aircraft on elevated STOL ports. The degree of fire and rescue protection needed at STOL ports will be determined by applying the critical area criteria expressed in AC 150/5210-6A. Modification of this criteria might be necessary for certain elevated STOL ports where the size of the port may limit the type of equipment which can be used. A.L.

N70-41085# Federal Aviation Administration, Washington, D.C. Aircraft Div.
OPERATIONAL RESEARCH RELATED TO STOL PORTS
J. Clay Staples *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 75-80 (See N70-41076 23-11)
Avail: NTIS

Activities undertaken by the FAA to gain the necessary knowledge and experience to assist in the establishment of realistic STOL port criteria, related airworthiness and operational criteria, and flight test procedures are briefly reviewed. Several programs being conducted for the FAA by NASA are discussed. In the absence of an elevated STOL port, tentative plans have been made to conduct tests on an airport which provides some of the characteristics of an elevated port. A.L.

N70-41086# Federal Aviation Administration, Washington, D.C.
PLANNING THE STOL AIR TRANSPORT SYSTEM
Thomas McNamara *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 81-92 ref (See N70-41076 23-11)
Avail: NTIS

Air traveler convenience is considered the most important factor in the planning of the STOL air transportation system. With STOL operations geared to the short haul market, less than 500 miles, locations of STOL ports will in all probability be widely dispersed and will serve the needs of many different groups of people. Some of the constraining factors effecting the planning for STOL ports include: (1) airspace limitations; (2) land limitations; (3) airport ground access; (4) environmental impact; (5) noise; and (6) financial considerations. A.L.

N70-41087# Federal Aviation Administration, Washington, D.C. Airports Service.
FEDERAL ASSISTANCE IN FUNDING STOL PORT DEVELOPMENT
Lamar E. Gutherie *In its* Papers presented at STOL Port Planning and Design Conf. 26 May 1970 p 93-97 (See N70-41076 23-11)
Avail: NTIS

Statutory definitions establishing guidance for identifying airports that can qualify for Federal assistance are reviewed. Three basic requirements are involved in obtaining Federal aid for airport development: eligibility of airport, sponsor, and development itself. Legislative definitions clearly include airports for STOL aircraft use. Legislation under consideration will increase the capability of the FAA to afford aid to public agencies for airport development by more than threefold. A.L.

N70-41130# Explosives Research and Development Establishment, Waltham Abbey (England).
A DESIGN FOR A ROTARY MACHINE TO ASSESS THE FRICTION SENSITIVENESS OF EXPLOSIVES AND PROPELLANTS
J. G. Rankine and H. C. Turner Feb. 1970 16 p
(AD-709042; ERDE-TN-16) Avail: NTIS CSCL 19/1

A machine for assessing the friction sensitiveness of explosives and propellants has been designed to operate at velocities up to 30 ft/s (10 m/s), with a maximum dead load of 300 lb (150 kg). This has been accomplished by allowing the peripheral face of a metal disc to act on a flat metal plate, the load being applied pneumatically. The motion of the disc is effected by means of a flywheel striking a movable latch. The prototype machine has successfully completed its initial tests. Load and velocity can be varied simply, and the time taken to perform the tests is less than with the modified pendulum machine upon which the action is based. Further proving trials will be needed before the use of the machine can be recommended as a standard test procedure.
Author (TAB)

N70-41131# Kaman Nuclear, Colorado Springs, Colo.
THE THEORY AND CAPABILITIES OF MAGNETICALLY DRIVEN FLYERS
Thomas F. V. Meagher and David C. Williams Jun. 1970 69 p refs
(Contract DASA-01-68-C-0084)
(AD-708449; KN-770-70-35; DASA-2440) Avail: NTIS CSCL 14/2

The basic theory governing the behavior of magnetically driven flyer plates is derived and discussed. Analytical tools capable of predicting the non-linear response of flyer plate systems are described and one such tool is utilized to predict the behavior of a typical capacitor bank-magnetically driven flyer plate facility. Practical applications and achievements, including instrumentation and bank diagnostics, of operating systems are described. Consideration is given to uncertainties arising from a lack of definition of the cushioning (air or magnetic) between the sample and flyer, the thermodynamic condition of the flyer at impact, and the degree of buckling of a curved flyer at impact with a curved test specimen. Particular attention is given to the high impulse capability of magnetically driven flyer plates. Theoretical predictions of the temperature rise in various materials due to I2R heating are presented along with hydrodynamic calculations of the pressure-time history resulting from magnetically driven flyer plate impacts on tape wound nylon phenolic. Included in the summary is a discussion of the need for magnetically driven flyer plate loadings of structural items.
Author (TAB)

N70-41195# Federal Aviation Administration, Washington, D.C. Airports Service.
THE 1980 METROPOLITAN AREA AIRPORT CAPACITY ANALYSIS. LOCATION: ATLANTA, GEORGIA Staff Study
Louis N. Million 19 Jun. 1969 24 p
Avail: NTIS

An example of the use of airport airfield capacity techniques in analyzing long range (ten or more years) airport needs for a metropolitan area is presented. The Atlanta Standard Metropolitan Statistical Area (SMSA) was selected as a representative location for preparation of this example. Several related factors were reviewed including population trends, economic development, highway, rail and waterway transportation systems, zoning plans, topography, and airspace. Airfield capacity is defined as that movement rate of aircraft using the runway-taxiway system which results in a reasonably acceptable average delay to operations. The analytical approach and procedures described are adaptable to any SMSA.
Author

N70-41198# National Aviation Facilities Experimental Center, Atlantic City, N.J.
GRAPHIC SIMULATION STUDY OF TWO SITES FOR A SECOND MAJOR AIRPORT IN THE ATLANTA AREA Final Report, Feb.–Apr. 1970
Sidney B. Rossiter Oct. 1970 51 p ref
(FAA-RD-70-63) Avail: NTIS

A graphic simulation study was made of the Atlanta terminal area to provide comparisons between two proposed sites for a second major airport based on air traffic control considerations. Terminal area air traffic control procedural plans were developed incorporating each new site. Through the use of a questionnaire, developed around factors that comprise an air traffic control subsystem, each site was evaluated by a panel of 12 air traffic control specialists for each of four different wind directions. The results of this evaluation indicated that Site D was significantly preferred for the west, northwest, and east landing directions with Site A being significantly preferred for a southeast direction of operation. Considering all wind directions, Site D was preferred over Site A when the wind directions were weighted based on percentage of occurrence, or when considered equal in weight. The primary reasons for this choice were the lesser interaction with satellite airports, more available airspace, fewer areas requiring critical vectoring, less interaction between Site D and the Atlanta airport for north/south departures, less coordination because of less compression of airspace, and no added effect on the satellite airports operations.
Author

N70-41273# Civil Aeronautics Board, Washington, D.C.
PROBLEMS OF AIRPORT CONGESTION BY 1975
Myron S. Heffter, Evans Wiley, and James Craun Sep. 1969 173 p refs
Avail: NTIS

Traffic handling characteristics are described for fourteen high density airports in the United States and Puerto Rico (Los Angeles, Atlanta, Miami, Boston, San Francisco, Philadelphia, Cleveland, Minneapolis, St. Louis, Memphis, Oakland, Denver, Las Vegas, and San Juan). Five airports already at saturation levels of operation are excluded from the discussion (JFK, LaGuardia, Newark, Washington National, and O'Hare). The major causes of airport congestion are identified as: (1) saturation of runways, (2) noise restrictions, (3) insufficient runway turnoffs, (4) lack of aprons and holding areas, (5) insufficient parking gates, and (6) inadequate highway approaches to airports and parking facilities.
E.C.

N70-41302# Federal Aviation Administration, Washington, D.C. Office of Aviation Economics.
WASHINGTON NATIONAL AND DULLES INTERNATIONAL AIRPORT FORECASTS, FISCAL YEARS 1970–1981
Nov. 1969 39 p
(AD-705087) Avail: NTIS

Forecasts for eight major traffic categories at both Washington National Airport and Dulles International Airport for fiscal years 1970 through 1981 are presented. These categories are air carrier passengers, all other passengers, express, freight, mail and aircraft movements for air carrier, general aviation and military. These forecasts indicate probable aviation demand for the Washington metropolitan area. They are not intended to imply that the physical capacity to fully meet this demand is available and in being today. These projections provide a foundation on which airport engineers and regional airport planning officials can make specialized studies and recommendations on how best to meet this demand. The report focuses on the period through fiscal 1976 and gives specific projections for each year, 1970 through 1976. Forecasts for fiscal years 1980 and 1981 are also included to meet longer-range planning needs.
Author

N70-41400# Department of Transportation, Washington, D.C.
A PRELIMINARY REPORT ON THE CLEVELAND BEFORE AND AFTER STUDY Interim Technical Report
George F. Wiggers May 1969 108 p refs
(PB-184060) Avail: NTIS

The Cleveland Before and After Study is an analysis of the rapid rail extension to Cleveland Hopkins Airport. A survey of airport users and employees at Hopkins Airport was conducted

before the start of rail service to the airport, and an after survey will be conducted one year later. The data from these surveys will be compared to determine trip time and cost factors influencing choice of the rapid rail to the airport over alternative modes of transportation. Progress of the study to date, and preliminary estimates of ridership and impact on the rapid rail by air passengers, indicate only marginal reduced congestion of highway facilities at the airport. Charts, tables, and maps are included to verify these estimates. Author

N70-41479*# National Aeronautics and Space Administration, Washington, D.C.
ADVENTURES IN RESEARCH: A HISTORY OF AMES RESEARCH CENTER, 1940-1965
Edwin P. Hartman 1970 673 p refs
(NASA-SP-4302) Avail: SOD $4.75; NTIS CSCL 14B

A historical survey of the Ames Research Center is presented, beginning with its founding in 1936 and continuing through 1965. The survey discusses early developments in aviation and concludes with the emphasis on space research from 1959 to 1965. The development of physical facilities for research are described in detail. R.B.

N70-41517# California Univ., Berkeley. Inst. of Transportation and Traffic Engineering.
RUNWAY MARKING STUDIES Final Report
Don O. Horning and Karl Mellander Washington FAA Aug. 1970 43 p
(Contract FAA-ARDS-434)
(FAA-RD-70-27) Avail: NTIS

To help evaluate the effectiveness of several different runway marking patterns under limited visibility conditions, a set of special composite photographs was prepared simulating a pilot's-eye view of the patterns from various points along the glide path. The set includes three marking patterns, the U.S. Standard (TSO-N10b) and two modified versions thereof, on both asphalt and concrete surfaces, as viewed under daytime visual-range conditions from 2400 ft down to 700 ft. Each of the composite photos consisted of two visual components combined through appropriate processing techniques. One component was made by photographing a 30:1 scale model runway layout in the UC-FAA Fog Chamber under a given set of conditions. The other component was taken from motion picture film showing the inside of a Boeing 707 flight simulator cockpit as viewed from the pilot's-eye position. The contrasts in the original scenes were matched in the photographs by means of suitable photometric controls. Author

N70-41528# Federal Aviation Administration, Washington, D.C.
FACILITY ESTABLISHMENT CRITERIA
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 15-19 (See N70-41526 23-02)
Avail: NTIS

The extent to which establishment criteria should incorporate number of people served, number of operations, type of mission, or type of use is investigated, along with the programs the FAA should follow to develop criteria changes. Specific recommendations include the use of seat capacity as the basis of the criteria, the revision of VORTAC airway structure to a modified grid plan founded on area navigation use, criteria proposals for the air traffic control tower, federal funding uses, joint military/civil use of airport facilities, and the establishment of a permanent joint Government/industry advisory council for long range planning purposes. A specific example concerning instrument landing system criteria development is presented. P.A.B.

N70-41530# Federal Aviation Administration, Washington, D.C.
FAA SERVICES AT NON-PUBLICLY OWNED AIRPORTS
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 27-36 (See N70-41526 23-02)
Avail: NTIS

Federal policy relative to facility establishment and operation at privately owned, public use airports is examined. Eligible FAA services, current policy for implementing the servies, and the scope of the four related federal programs are presented in graphical form. Considerations in airport development, the non-federal Navaid program, state airports, and the use of part-time facilities to support high peaks of activity are discussed. The need for a policy review is recognized; a chart showing anticipated timing and steps involved in developing a policy change is included. P.A.B.

N70-41534# Federal Aviation Administration, Washington, D.C.
GENERAL AVIATION DATA SYSTEMS
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 53-55 (See N70-41526 23-02)
Avail: NTIS

The adequacy of current programs to provide meaningful general aviation data, their use as a base for future systems planning, and the willingness of the community to support the necessary expanded data programs are discussed. Policy and objectives in data system development are considered, in the areas of airports, airmen, aircraft, air traffic, and safety information. The need for a nationwide FAA-state aviation data collection program is suggested. P.A.B.

N70-41537# Federal Aviation Administration, Washington, D.C.
AIRPORT/AIRWAY COST ALLOCATION STUDY
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 73-77 (See N70-41526 23-02)
Avail: NTIS

The cost allocation study, as specified in the Bill H.R. 14465, is discussed with reference to the language of the legislative provisions, current estimates of airport and airway expenditures, procedures for government/industry consultation in conducting the study, and the study scope and content. The ten-year funding requirement and the trust fund provisions contained in the legislation are considered. Coordination of the work statement with other interested government agencies and immediate establishment of a government/industry working group are recommended. P.A.B.

N70-41540# Federal Aviation Administration, Washington, D.C.
AIRPORT CLASSIFICATION AND CERTIFICATION
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 115-132 (See N70-41526 23-02)
Avail: NTIS

The imposition of minimum airport safety standards is considered; the pros and cons of airport certification and inspection are discussed. It is stated that, since certification is incorporated in the Airport/Airways Development and Revenue Act, it will be enacted. With respect to the proposed airport classification system, several alternate suggestions are presented. Charts concerning these suggested systems, a regional classification category with a validation matrix, and estimated travel times with respect to regional airport development are included. A more aggressive federal role in airport planning and siting is recommended. P.A.B.

N70-41555# General Dynamics/Electronics, Rochester, N.Y.
SCATE MARK 5, FEASIBILITY DEMONSTRATION, VOLUME 1 Final Technical Report, 1 Jul. 1968-20 Oct. 1969
Clifford C. Price Jan. 1970 273 p refs
(Contract DAAB07-68-C-0440)
(AD-709638) Avail: NTIS CSCL 14/2

The report summarizes the results of a feasibility demonstration of SCATE MK V held at the Contractors plant in Rochester, N.Y. on 11 and 12 September 1969. SCATE MK V is a new generation of computer-controlled automatic test equipment (CATE) designed

for field maintenance of Army communications and electronics equipment. It significantly reduces the size, programming costs and technical training requirements of support equipment while providing more comprehensive test and diagnostic capability than other systems in use today. Stimulus, measurement computer and switching subsystems are described, including specification data for each subsystem unit. SCATE MK V can be programmed to perform performance and fault diagnosis testing down to the replaceable module or subassembly level. The SCATE English-language programming language and interpretive compiler is described and a programmers manual is included. Test data taken during the demonstration is reproduced along with informative notes describing each test performed. The characteristics of SCATE MK V, in the areas of technical capability, size, weight, reliability, maintainability, personnel subsystems, shelter mounting, training requirements, cost and bulk of test programming are discussed. Author (TAB)

N70-41585# Technische Univ., Berlin (West Germany). Fakultaet fuer Bauingenieurwesen.

DISTANCE REQUIREMENTS DURING TAKEOFFS AND LANDINGS [LAENGENBEDARF BEI STARTS UND LANDUNGEN]

Guenther Bentfeld (Ph.D. Thesis) Mar. 1968 141 p refs In GERMAN

Avail: NTIS

The distances of the takeoff and landing runs, the spacing of the liftoff and touchdown points, and aircraft speed on the runways were investigated with respect to differences in classification of standard runway lengths and distance requirements. Factors considered in clarification of the problem are international standards for classification of airports, formulas by which takeoff distances can be approximately calculated or takeoff motion can be presented in discrete steps, performance nomographs for those aircraft travelling the longest distances, and observational results of takeoff and landing distance requirements in actual operations. The measurement techniques used in the study are described and recommendations are made for additional studies with respect to the changes brought about by increased introduction of jet aircraft into civil aviation. Transl. by R.B.

N70-41602# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

EVALUATION OF SOIL STRENGTH OF UNSURFACED FORWARD-AREA AIRFIELDS BY USE OF GROUND VEHICLES Final Report

George M. Hammitt, II May 1970 46 p refs *Its* Misc. Paper No. S-70-14

(AD-709589) Avail: NTIS CSCL 1/5

The report describes a method for rapidly determining the soil strength at forward-area airfields. Soil strength indications are determined by measuring rut depths created by traffic of standard military ground vehicles. Initially, an office study was conducted that established the potential of such a method. Then limited field verification tests were conducted with four standard military ground vehicles operated on a prepared unsurfaced heavy clay subgrade. First-pass rut depths were measured for each vehicle operated empty and with maximum cross-country loading. The results of this testing indicated the feasibility of predicting soil strength based on one-pass rut depth caused by military ground vehicles. Author (TAB)

N70-41610# Naval Postgraduate School, Monterey, Calif.

AN INVESTIGATION OF A TRANSONIC TURBINE TEST RIG

Stewart Gary Esdaile (M.S. Thesis) Oct. 1969 126 p refs

(AD-709406) Avail: NTIS CSCL 21/5

The Transonic Turbine Test Rig installed in the Turbo-Propulsion Laboratory at the Naval Postgraduate School was designed such that losses in nozzle and rotor blading and overall performance characteristics can be determined for operation at several combinations of blade configurations, pressure ratios and speeds. This study relates the empiracal data for stator loss coefficients to those determined for the converging-nozzle stator presently installed, and discusses reasons for some of the discrepancies. Also discussed are results of the flow nozzle calibration, locked rotor data, and temperature and inlet swirl effects. A method is proposed to reduce these effects for future work on the Turbine Test Rig. Author (TAB)

N70-41658# National Accelerator Lab., Batavia, Ill.

[CONSTRUCTION OF THE PROTON BEAM ACCELERATOR] Monthly Report, May 1970

F. T. Cole 31 May 1970 12 p

(NAL-42) Avail: NTIS

The fabrication and 10-MeV operation of the linac are discussed, and progress on the booster, main accelerator, beam transfer system, and experimental facilities is outlined. Construction progress is reported. NSA

N70-41677# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SUPPORT APPARATUS FOR DYNAMIC TESTING Patent

George Landwehr von Pragenau and Wilhelm Angele, inventors (to NASA) Issued 3 Jan. 1967 (Filed 25 May 1964) 8 p Cl. 73-116

(NASA-Case-XMF-01772; US-Patent-3,295,366; US-Patent-Appl-SN-370135) Avail: US Patent Office CSCL 14B

Hydraulic support equipment for the full scale dynamic testing of a large rocket vehicle under near free flight conditions is described. The apparatus has a vertically floating piston with substantially frictionless means for regulating oscillatory motion. Self-adjusting, frictionless bearings lie on the piston and transmit the weight of the vehicle to the piston. The piston allows for vertical motion and the bearings allow for horizontal and/or rotational motion. The means for maintaining a thick oil film for the hydrostatic bearings and for keeping the vehicle in position are described. N.E.N.

N70-41745# National Accelerator Lab., Batavia, Ill.

[DEVELOPMENT OF LARGE PROTON BEAM ACCELERATOR] Monthly Report, Apr. 1970

F. T. Cole 30 Apr. 1970 12 p

(NAL-41) Avail: NTIS

It was announced that the first proton beam may be accelerated by mid-1971 to an energy of 500 GeV. Construction progress on the linac, booster, main accelerator, beam transfer system, and experimental facilities is summarized. A statement concerning the schedule and energy is included. NSA

N70-41774# Aerospace Research Labs., Wright-Patterson AFB, Ohio. General Physics Research Lab.

A RADIATION PROTECTION INTERLOCK SYSTEM FOR THE 8-MeV ICT TANDEM ACCELERATOR Final Report, Aug. 1969–Jan. 1970

P. Kivett, D. Breitenbecher, and H. J. Hennecke Jun. 1970 45 p

(AD-709682; ARL-0094) Avail: NTIS CSCL 18/6

A radiation protective system for a tandem accelerator utilizing interlocks, electric door locks and audio-visual warning devices is described. The system consists of four types of units. A master control panel (accelerator operating condition monitor determines interlock and warning conditions by monitoring accelerator variables. An interlock control panel (interlock indicator and control panel) controls access to radiation areas. Warning lights and siren units (so called) present visual and audible indications of radiation conditions and abrupt changes in radiation conditions. Located at

each door is a unit (entrance interlock indicator unit) which is connected to a Micro-Switch and door lock. Responsibility for radiation safety is placed on the person operating the accelerator who is aware of the existing radiation conditions and has control of the access to radiation areas. Care has been taken in order to make the interlock system as Fail-safe and reliable as possible. Author (TAB)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N70-40405 National Lending Library for Science and Technology, Boston Spa (England).
POTENTIAL FLOWS THROUGH ROTATING IMPELLER
E. Sorensen (Ph.D. Thesis) 8 Jun. 1970 25 p Transl. into ENGLISH from Z. Angew. Math. Mech. (East Germany), v. 7, 1927 p 89–106
(NLL-EE-Trans-1302-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.

With an optional number of vanes on a rotating impeller, the potential flow was determined using Fourier series coefficients. Mathematical models are also presented for calculating complex w-plane and water velocity over plane surface. J.A.M.

N70-40442# National Aerospace Lab., Tokyo (Japan).
DRAG MEASUREMENT IN NEARLY-FREE-MOLECULE-FLOW REGIME
Akira Onji and Kiyoshi Yamamoto 1970 8 p refs In JAPANESE; ENGLISH summary
(NAL-TR-191) Avail: NTIS

The measurements of sphere drag in a nearly free molecule flow regime are presented. The measurements were made using a rotating arm apparatus. The circulating speed of the models mounted on the arm tip decreases due to the drag force and other effects such as mechanical friction and the arm drag. From the measurement of this deceleration rate and by subtracting the outside effects, the drag coefficients of the model were determined. The results are compared with existing theories and experimental data. Author

N70-40450 Rice Univ., Houston, Tex.
A NUMERICAL METHOD OF SOLUTION FOR THE EQUATIONS DESCRIBING THE COMPRESSIBLE, TURBULENT, TIME-DEPENDENT FLOW OF AN IDEAL GAS NEAR A SOLID BOUNDARY
James Edward Park (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-19326

The use of digital computers to solve the fundamental equations of fluid mechanics is presently a developing art. One method of attack, the time-marching an unsteady technique, has been applied to the solution of those equations describing a turbulent, compressible boundary layer flow. A finite difference representation for the appropriate partial differential equations developed to describe the mean behavior of the turbulent flow has been solved for free stream Mach numbers of 0.13 and 0.8. Derivations of an empirical model for the turbulent stress tensor and of the proper numerical stability conditions are presented. Combined model and stability requirements force the use of an implicit difference form for the time variable. Results are presented for the low Mach number case which demonstrate the applicability of the empirical model, the stability analysis and the boundary conditions. Satisfactory agreement is obtained between correlated experimental data from the literature and calculated profiles of local skin friction coefficient and velocity. Dissert. Abstr.

N70-40465# National Aerospace Lab., Tokyo (Japan). First Aerodynamics Div.
TRANSIENT COUETTE FLOW OF RAREFIED BINARY GAS MIXTURES
Katsuhisa Koura Mar. 1970 12 p refs
(NAL-TR-192T) Avail: NTIS

The transient Couette flow problem of rarefied binary gas mixtures is studied for the nonlinear case, M sub i > or = to 1: one of the plates with equal plate temperatures is accelerated impulsively. The method of solution is the Monte Carlo method. The physical space is divided into macroscopically small cells. The change in the distribution function in a cell during a time interval, which should be sufficiently small in comparison with the characteristic times is obtained by following the test particles for each molecular event through the event; i.e., molecular drift, external force, or molecular collision. The flow field is calculated for Maxwellian molecules and the range of Knudsen number (from free molecular to transition flow regime). The relaxation phenomena of a gas mixture with the boundary effects are observed. Of particular interest are an epochal relaxation due to the molecule-surface collision and the temperature overshoot near the moving plate. The steady-state solutions, which are obtained from the long-time results, are also presented. The effects of Knudsen number, mixture ratio, and gas-surface interaction are investigated, and the separation phenomena between the species are observed. Author

N70-40468 Rice Univ., Houston, Tex.
AN INVESTIGATION OF THE STABILITY OF FLOWS USING THE DIRECT METHOD OF LIAPUNOV
Ernest Losson Kistler 1969 157 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-19308

Presented is an entirely new approach to the classical problem of laminar flow stability. Current state-of-the-art is reviewed in terms of the basic mathematical model and the analytical techniques used to investigate stability of the math model. The Liapunov Direct Method is applied to the full three-dimensional Navier-Stokes equations of motion and a general criteria for stability is obtained. This criteria is reduced in two-dimensions to compare with solutions of the Orr–Sommerfeld equation. The two-dimensional criteria is applied to Couette flow and the flow is shown to be stable for all disturbances. Dissert. Abstr.

N70-40469 Rice Univ., Houston, Tex.
STUDIES OF THE CONDITIONS UNDER WHICH GASEOUS DIFFUSION COEFFICIENTS CAN BE MEASURED FOR DILUTE AND MODERATELY DENSE GASES USING THE DISPERSION MODEL FOR LAMINAR FLOW IN TUBES
Alexander Tzi-chiang Hu (Ph.D. Thesis) 1969 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-19301

Studies of the conditions under which meaningful gaseous diffusion coefficients can be measured for dilute and moderately dense gases using the dispersion model for laminar flow in long circular tubes were carried out. Experimental modifications necessary for close approximation of the model were studied by making a number of improvements over previous efforts. Diffusion data were taken on the systems tritiated methane in methane and tritiated methane in tetrafluoromethane at 25 C for pressures up to 60 atm. Data were also taken on argon, carbon dioxide, methane, and nitrogen in helium at 50, 25, 0, –25 C for pressures up to 60 atm. Good agreement was obtained between the value of Taylor's diffusion calculated from the experimental data and that predicted from theory. Dissert. Abstr.

N70-40472# Waterloo Univ. (Ontario).
FLOW DEVELOPMENT IN CONICAL DIFFUSERS WITH ANNULAR INJECTION AT INLET
W. B. Nicoll and B. R. Ramaprian Feb. 1969 29 p refs
(RR-14) Avail: NTIS

The occurrence of stall in widely divergent conical diffusers can be delayed by injecting high velocity air through an annular slot at the diffuser inlet. Results of theoretical and experimental investigation of the flow development in such cases are presented. A finite difference method suggested by Patankar and Spalding is applied to predict the flow development. Prandtl's mixing length hypothesis is assumed with a simple mixing length model. The experimental data have been obtained from three conical diffusers of cone angles 10 deg, 20 deg and 30 deg at different injection rates. The predictions are found to compare well with experiments if a first order correction is applied for the asymmetry present in the experimental flow. Experimental data on the effect of injection on pressure recovery and diffuser efficiency are reported in a companion paper. Author

N70-40481 Princeton Univ., N.Y.
ANALYSIS OF MOTION IN THE ORTHOGONAL RHEOMETER. CONSTITUTIVE RELATIONS AND POLYMER STUDIES
Stuart Jacob Kurtz (Ph.D. Thesis) 1969 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-18170

A study was made on the dynamic properties of crosslinked polyethylene in the melt state. Low density polyethylene was crosslinked by dicumyl peroxide in concentrations from 0.00 to 1.0%, gel point approximately 0.07%, and subsequently tested in the rheometer. Measurements were recorded for the dynamic variables eta and G as well as a normal force variable over a shear rate range from 0.0001/sec to 10/sec. The zero shear viscosity was found to increase with crosslinking density though not in a simple manner. It is suggested that because of the particular flow pattern in the rheometer it should be possible to find the association between the dynamic viscosity and the steady flow viscosity. The behavior of the crosslinked polyethylenes below the gel point and above the gel point are contrasted since the gel point appears to be a critical point even for very small strains. These results are then related to a reduced form of the simple fluid model. Dissert. Abstr.

N70-40485# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
A MODIFIED ENTRAINMENT THEORY FOR THE PREDICTION OF TURBULENT BOUNDARY LAYER GROWTH IN ADVERSE PRESSURE GRADIENTS
W. B. Nicoll and B. R. Ramaprian Apr. 1968 49 p refs
(RR-9) Avail: NTIS

An approach based on the entrainment theory is presented as a tool for the prediction of turbulent boundary layer growth in adverse pressure gradients. The rate of entrainment of free stream fluid by the boundary layer is assumed to be a unique function of the shape factor. A two parameter velocity profile has been assumed, which reduces to the Spalding profile for zero pressure gradient flows and to the half-power profile of Stratford for separating flows. The integral equations of continuity and momentum are solved with the above empirical input to predict the growth of the boundary layer parameters, both in two-dimensional and axi-symmetric flows. The predictions are compared with some of the available experimental data in both the cases. The technique is found to give improved predictions compared with those of previous methods. Results in the case of conical diffusers indicate that the theory predicts slightly higher shape factors than actual, especially in the far downstream portions of the diffuser and thus furnishes a slightly conservative method for design. Author

N70-40487 Stanford Univ., Calif.
A STUDY OF STEADY, CLOSED STREAMLINE FLOWS AT LARGE REYNOLDS NUMBER
Leslie Gary Leal (Ph.D. Thesis) 1969 243 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 69-17437

The effects of such items as blockage, size and position of the splitter plate and spanwise nonuniformities were carefully examined. The effect of injection of relatively low velocity fluid into the recirculating wake through a slot in the base of the bluff body (known as base bleed) was studied experimentally for $0 \leq Vh/Ud \leq 0.15$, where V is the initial velocity of the bleed fluid, U the velocity in the freestream, d the height of the base and h the height of the bleed slot. The asymptotic behavior of the near wake region, for large R, is dominated by the structure and properties of the separated shear layer and the surrounding outer flow. Numerical solutions to the full Navier-Stokes equations were obtained for flow past a flat plate of length L in which a finite slip velocity U sub o opposite in direction to that of the free stream is imposed. This configuration represents, for example, an idealized model of the countercurrent flow of a gas and a falling liquid film. Dissert. Abstr.

N70-40519# Naples Univ. (Italy). Aerodynamics Inst.
UNIFIED MACROSCOPIC THEORY FOR MULTI-PHASE NON-EQUILIBRIUM FLOWS Annual Scientific Report, 15 Nov. 1968 – 14 Nov. 1969
Luigi G. Napolitano Dec. 1969 99 p refs
(Contract F61052-68-C-0035)
(AD-708512; IA-150; AFOSR-70-1845TR) Avail: NTIS CSCL 20/4

The report presents a general, rigorous, unitary formulation of a macroscopic theory for two-phase non equilibrium flows based on a two-fluid approach. This general theory includes, as particular cases, both the theory of superfluid helium and that of more conventional media in which any number and type of internal and/or external irreversible processes may take place. The theory hinges on a careful rigorous and coherent application of thermodynamics and its main fundamental feature is the reckoning that there are no a-priori reasons for assuming that: (a) the total energy of a composite system in motion can be always separated in a purely kinetic and a purely thermodynamic part; (b) the dissipative fluxes of extensive quantities (i.e. the fluxes contributing to the production of entropy) are necessarily those measured in a frame moving with the c.g. the composite system. The nature and implications of these two assumptions are discussed at length throughout the report, both per se and in relation with other fundamental questions such as, for instance, the characterization of constrained and/or unconstrained equilibria in terms of an energy fundamental relation or of the vanishing of entropy production. Two applications are given. First it is shown how the theory of superfluidity is recovered as a particular case. Secondly a comparison between the classical (one-fluid) and the two-fluid theory is carried out and the approximations inherent to the classical theory are discussed. Author (TAB)

N70-40528# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
ON THE APPLICATION OF THE PRANDTL – KOLMOGOROV MODEL OF TURBULENCE TO FULLY-DEVELOPED TURBULENT PIPE FLOW
W. B. Nicoll and B. R. Ramaprian (Indian Inst. of Sci., Bangalore) Jul. 1970 14 p refs
(TN-13) Avail: NTIS

This model incorporated into flow-development prediction schemes by a number of investigators. In these prediction techniques several constants are introduced into the conservation equations via assumptions made about diffusion and source terms. In the present note a simple method is presented for the evaluation of these constants from certain well-established characteristics of

fully-developed turbulent flow in smooth circular pipes. It will be shown that the resulting values allow accurate prediction of other characteristics of the flow field. Author

N70-40533# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
THE EFFECTS OF GEOMETRY AND SEPARATION IN A HYDRAULIC JET-PIPE VALVE
S. A. Alpay Feb. 1970 26 p refs
(RR-17) Avail: NTIS

The structure of the flow in a jet-pipe valve is complicated and not amenable to theoretical analysis. The steady state characteristics of the performance of the valve depend on a number of geometric and operational parameters. In this study the influence of the inclination of the receiving hole axis and the effects of an eccentric chamfering at the receiving holes were investigated experimentally. Comparison of the results obtained for these configurations with those of a jet-pipe valve with its axis parallel to the jet axis and with concentric chamfering provides the designer with information about the selection of the geometry of receiving holes. An attempt was made to photograph the flow patterns at the receiving hole entrance and to record simultaneously the related pressure fluctuations. The results revealed severe separation and mixing effects, which are presumably the cause of the chattering observed under certain operational conditions. Author

N70-40537 IIT Research Inst., Chicago, Ill.
EXPERIMENTAL INVESTIGATION OF RECIRCULATION PATTERNS IN THE INITIAL REGION OF COAXIAL JETS
Tzvi Rozenman (Ph.D. Thesis) 1969 196 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-18522

An experimental study is presented of the initial region in a turbulent coaxial jet flow. The initial region is the region of the flow upstream of the self-similar flow regime and is strongly influenced by inlet geometry and velocity profile. The investigation is limited to low speed coaxial jets which can be considered incompressible. The outer air stream velocity was held constant at 48 ft/sec and the inner velocity varied from 0 to 48 ft/sec, to give velocity ratios from infinity to one. The inner stream was either air or Freon 12 which has a density four times that of air. Experimental measurements were made with a hot wire anemometer system and static pressure probes. Shadowgraph pictures were taken to illustrate the flow patterns in the initial region. The data includes average velocity and turbulence intensity in the initial region, and center line and radial distribution of static pressure. Dissert. Abstr.

N70-40540 Princeton Univ., N.J.
A KINETIC-THEORY ANALYSIS OF TWO IMPINGING HYPERSONIC LOW DENSITY STREAMS
Dah-Chen Sun (Ph.D. Thesis) 1969 170 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-18192

The effect of first collisions is studied when two streams consisting of hard sphere molecules impinge onto each other at an angle. The first iteration of this system is carried out both analytically and numerically. The region of validity of the first iteration is found to include a small neighborhood of the impingement point and two extended strips along the initial lines of intersection. Results show that the leading order term representing the collisional effect is linear in gamma, and that the leading order angular dependence of the collisional effect is a line of intersection. By choosing the free parameters in the analysis, various physically realistic situations can be obtained and for these cases both the flow field and the surface properties are computed. Results show that the flow field properties are insensitive to the geometrical details of the surface and that the particle and momentum flux toward the surface due to the collisional products rapidly cause the surface properties to depart from the predictions of the free molecular flow theory. Dissert. Abstr.

N70-40561 Michigan Univ., Ann Arbor.
THE CONDENSATION OF A METAL VAPOR IN A RAPIDLY EXPANDING INERT CARRIER GAS
Donald Dean McBride (Ph.D. Thesis) 1969 213 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-18056

The principal objectives of this study were the determination of the size of the particles formed, and the point at which condensation could first be detected in a vapor-gas mixture expanded in a converging-diverging nozzle. The working fluid chosen was zinc vapor in a helium carrier gas. A hotshot wind tunnel was used for the first time to produce the superheated zinc vapor-helium mixture which was then expanded through a hypersonic nozzle. The onset of condensation was determined by pressure measurements along the length of a supersonic nozzle exhausting to atmosphere. This onset was located by a noticeable deviation of static pressure from its frozen isentropic value. It was found that the particle sizes typically lie in a very narrow distribution (the diameters of 80% of the particles are within a 100 A range). The particle size distribution curve peaks at 135 A indicating the majority of the particle sizes are clustered about this value. Dissert. Abstr.

N70-40573 California Univ., Berkeley.
AN EXPERIMENTAL INVESTIGATION OF NORMAL SHOCK WAVE VELOCITY DISTRIBUTION FUNCTIONS IN MIXTURES OF ARGON AND HELIUM
Laurence Neil Harnett (Ph.D. Thesis) 1969 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-18932

The electron beam-spectroscopic technique developed by Muntz for measuring simple one-dimensional moments of helium velocity distribution functions was extended for use with argon. Measurements were made on argon-helium gas mixture normal shock waves at low Mach numbers. Intensity versus wavelength profiles of single spectral lines for each gas were determined at fixed points within the shock waves with a Fabry–Perot interferometer. Lines of sight both perpendicular and parallel to the flow direction were chosen. By using appropriate calibration functions, the effect of Doppler broadening on the line structure was isolated from all other sources of line broadening, and in this way curves of parallel and perpendicular temperature for each gas as functions of position were constructed. Macroscopic velocities were measured by determining the blue shift in the line profiles when the line of sight shifted from the perpendicular to the parallel direction. The data thus obtained provided detailed information on the variation of species velocities and parallel and perpendicular temperatures within the shock waves. These results were then compared with existing theories and other experimental results. Dissert. Abstr.

N70-40612 University of Southern Calif., Los Angeles.
THE UNSTEADY FLOW FIELD CREATED BY THE ARBITRARY EXPANSION OF A PISTON FOLLOWING AN ENERGETIC, IMPULSIVE START
Jeffrey William Kirsch (Ph.D. Thesis) 1969 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-19381

The original impulse initiates a strong shock wave which precedes the (expanding) piston surface. An asymptotic analysis is presented wherein the problem is considered in the Newtonian limit of large shock compression ratio and infinite shock propagation speed. The theory treats the interaction of a thin, dense shock layer and an inner, rarefied flow region, the entropy wake, which is reduced to an ordinary differential equation for the shock position. Via the equivalence principle, the problem in hypersonic small disturbance theory is that of hypersonic flow around slender

symmetric bodies with blunted tips. In the theory's development, the pressure-volume relation of Cheng is recovered and extended to a higher order. It is shown that reattachment of the shock layer to the inner surface will occur. Dissert. Abstr.

N70-40615# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
THE COUETTE-FLOW MODEL IN TURBULENT BOUNDARY LAYERS
H. L. Evans, J. F. Lea (Southern Methodist Univ.), and D. A. Swayne Feb. 1970 95 p refs
(RR-16) Avail: NTIS

A mathematical model for the law-of-the-wall in turbulent boundary layers is developed based on: (1) the Couette-flow hypothesis that gradients of variables in the flow direction are negligible compared with transverse gradients; and (2) a modified mixing-length model for the contribution of turbulent mixing to the effective viscosity and the effective thermal conductivity. The flow model is designed to include, among other things, the effects of a favorable or adverse pressure gradient, mass transfer in either direction through the wall, and various levels of wall roughness. For flows with a skin friction which is near vanishing point, the familiar similarity variables based on the friction velocity must be changed for a set based on another reference velocity; usually the pressure-gradient velocity will suffice, but for one specific flow the mass-transfer velocity is more appropriate. Author

N70-40632 Michigan Univ., Ann Arbor.
AN INVESTIGATION OF THE EFFECT OF CAVITATION BUBBLES ON MOMENTUM LOSS IN TRANSIENT PIPE FLOW
Michael Ernest Weyler (Ph.D. Thesis) 1969 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-18136

Comparison of pressure-time plots for nearly saturated water indicated that the amount of undissolved air in the fluid increased during the transient, that the energy and momentum loss increased with a decrease in the undissolved air content, and that the undissolved air originated at the pipe wall. Two mechanisms associated with the growth and collapse of cavitation bubbles, viscous dissipation and non-adiabatic compression and expansion, were postulated to account for the increased momentum loss. The latter energy dissipation is interpreted in terms of a wall shear force, denoted as the Bubble Force Term, which depends upon the pressure changes occurring in the system, the amount of undissolved air in the system, and an empirically determined constant. This constant was determined for each data set by a computer simulation based on the characteristics method for a one-dimensional pipe flow. The constant was found to be a function of the fraction of undissolved gas in the pipe system, as determined from the wave speed after the transient. Dissert. Abstr.

N70-40655# Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
CONDENSATION IN A CONTOURED-NOZZLE SHOCK TUNNEL. REPORT FOR JANUARY–APRIL 1970
Robert L. Varwig and Stephen B. Mason 1 Jul. 1970 29 p refs
(Contract F04701-69-C-0066)
(AD-708475; TR-0066(5240-10)-11; SAMSO-TR-70-228) Avail: NTIS CSCL 20/4

The onset of condensation in a hypersonic shock tunnel was investigated to determine the limiting temperature to which the gas may be expanded. Previous research indicated some supercooling could be obtained; however, a confident assessment could not be made because of scatter in available experimental results. Static wall pressure and pitot pressure, which vary with condensation, were measured, while reservoir temperature was reduced for constant reservoir pressure. Under these conditions, measurements were made of condensation and supercooling. Author (TAB)

N70-40669*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GROWTH DUE TO BUOYANCY OF WEAK HOMOGENEOUS TURBULANCE WITH SHEAR
Robert G. Deissler Washington Oct. 1970 14 p refs
(NASA-TN-D-6026; E-5676) Avail: NTIS CSCL 20D

An analysis is made to determine how the energy in a weak homogeneous turbulence with buoyancy and shear changes with time. It is shown that, although the turbulence ultimately decays when buoyancy is absent, the presence of buoyancy counteracts the decay, and the turbulent energy grows at large times. Author

N70-40670*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STABILITY OF PLANE POISEUILLE FLOW WITH HEAT TRANSFER
Merle C. Potter (Mich. State Univ.) and Edwin J. Graber Washington Oct. 1970 12 p refs
(NASA-TN-D-6027; E-5818) Avail: NTIS CSCL 20D

The influence of heat transfer on the stability of a plane Poiseuille flow in a channel is considered. The primary liquid flow is affected by the heat transfer through the variation in viscosity with temperature. Additional viscosity gradient terms are included in a modified Orr–Sommerfeld equation and it is the presence of these terms which leads to a prediction of more unstable flows, for without the inclusion of these extra terms, the flow is stabilized. The results show that a temperature difference between the walls is always destabilizing. Author

N70-40679# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Research Lab.
TURBULENT MIXING OF SUPERSONIC JETS Final Report
Ronald L. Haugen May 1970 102 p refs
(AD-708735; ARL-70-0078) Avail: NTIS CSCL 21/2

The mixing of compressible turbulent jets is investigated theoretically. Two solution techniques are presented. A FORTRAN IV computer coding is included for each technique. In the first method, the problem is solved by first writing the momentum and energy equations in Crocco variables. The resulting coupled pair of integral equations are solved numerically using a method of successive approximation. In the second method, the problem is solved, assuming self-similar solutions, by applying a coordinate transformation. The resulting coupled pair of nonlinear ordinary differential equations are solved numerically. Author (TAB)

N70-40686# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
DEGASSING OF FLUIDS BY ACOUSTIC WAVES [ENTGASUNG VON FLUESSIGKEITEN DURCH SCHALLWELLEN]
Egge Barnstedt (Ph.D. Thesis) Sep. 1968 149 p refs In GERMAN
(D-83) Avail: NTIS

Degassing of liquids by exposure to an acoustic field results in compression of the gas bubbles with subsequent expansion caused by the concentration difference between bubble surface and surrounding liquid. Equations for calculating the developing process are presented and a mathematical model is developed for a degassing analysis on fluids. Transl. by G.G.

N70-40737*# Washington Univ., Seattle. Dept. of Mechanical Engineering.
INFLUENCE OF SUCTION ON SHOCK WAVE-TURBULENT BOUNDARY LAYER INTERACTIONS FOR TWO-DIMENSIONAL AND AXIALLY SYMMETRIC FLOWS, 16 SEPTEMBER 1967 – 30 JUNE 1969
William R. Seebaugh and Morris E. Childs Washington NASA Sep. 1970 140 p refs
(Grant NGR-48-002-047)
(NASA-CR-1639) Avail: NTIS CSCL 20D

An analytical and experimental investigation was conducted to study interactions of conical shock waves and turbulent boundary layers representative of those occurring on the cowl surfaces of axially symmetric inlets with supersonic internal compression. The analytical method considers the effects of boundary-layer removal from the region of shock wave-boundary layer interaction. Provision was made in the experimental apparatus for suction through normal perforations located upstream of or within the regions of interaction. In the development of the analytical model, a control volume was defined about the region of interaction, the velocity profiles upstream and downstream of the interaction region were assumed to be power laws, and the integral continuity and momentum equations were written for the control volume. For a given suction configuration, specification of a suction flow rate permitted solution for the boundary-layer thickness and power-law velocity-profile parameter downstream of the interaction region. Analytical results are presented in the form of boundary-layer thickness ratios across the interaction region and power-law parameters downstream of the interaction region. Author

N70-40769# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
COLLAPSE OF AN INITIALLY SPHERICAL VAPOR CAVITY IN THE NEIGHBORHOOD OF A SOLID BOUNDARY
Milton S. Plesset and Richard B. Chapman Jun. 1970 33 p refs
(Contract N00014-67-0094-0009)
(AD-708453; Rept-85-49) Avail: NTIS CSCL 20/4

Vapor bubble collapse problems lacking spherical symmetry are solved using a numerical method designed especially for these problems. Viscosity and compressibility in the liquid are neglected. The method uses finite time steps and features an iterative technique for applying the boundary conditions at infinity directly to the liquid at a finite distance from the free surface. Two specific cases of initially spherical bubbles collapsing near a plane solid wall were simulated: a bubble initially in contact with the wall, and a bubble initially half its radius from the wall at the closest point. It is shown that the bubble develops a jet directed towards the wall rather early in the collapse history. Free surface shapes and velocities are presented at various stages in the collapse. Author (TAB)

N70-40821# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
THERMAL EFFECTS IN THE FREE OSCILLATIONS OF GAS BUBBLES
Richard B. Chapman and Milton S. Plesset Jun. 1970 14 p refs
(Contract N00014-67-A-0094-0009)
(AD-708454; Rept-85-50) Avail: NTIS CSCL 20/4

A theory is developed from first principles which includes all the important physical processes which affect the frequency of the free oscillations of a gas bubble. The components of the damping: viscosity, thermal conduction in the gas, and acoustic radiation are all determined. Numerical results for the damping are given for air bubbles in water. Author (TAB)

N70-40947# Michigan Univ., Ann Arbor. Cavitation and Multiphase Flow Lab.
ASYMMETRIC BUBBLE COLLAPSE STUDIES Final Report, 1 Nov. 1966 – 30 Apr. 1970
Frederick G. Hammitt Jun. 1970 8 p refs
(Contract DAHC04-68-C-0007)
(AD-709651; AROD-6310-16-E) Avail: NTIS CSCL 20/4

The report presents a brief outline of the results of research which was concerned with experimental and theoretical studies of the collapse of cavitation or sub-cooled boiling bubbles under the influence of various asymmetries such as a pressure gradient, the proximity of a wall, an initial asymmetry, etc. Author (TAB)

N70-40950# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
TRANSIENT AND ASYMPTOTICALLY STEADY FLOW OF AN INVISCID, COMPRESSIBLE GAS PAST A CIRCULAR CYLINDER
Gino Moretti Apr. 1970 48 p refs
(Contract DAHC04-69-C-0077; ARPA Order 1442)
(AD-708898; PIBAL-70-20) Avail: NTIS CSCL 20/4

A numerical analysis is made of the invescid flow produced by a cylinder which accelerates from a state of rest to a constant, subsonic speed in a gas at rest. All features of the numerical solution are explained on physical grounds. Consequently, ways are suggested to computed steady subsonic flows around obstacles with a maximum accuracy and a minimum computational time. Author (TAB)

N70-41024# Information Research Associates, Inc., Berkeley, Calif.
THE MACYL8 HYDRODYNAMIC CODE: A NUMERICAL METHOD FOR CALCULATING INCOMPRESSIBLE AXISYMMETRIC TIME-DEPENDENT FREE-SURFACE FLUID FLOWS AT HIGH REYNOLDS NUMBER
John W. Pritchett 15 May 1970 60 p refs
(Contract N00014-70-C-0260; ARPA Order-1538)
(AD-709142; IRA-TR-1-70) Avail: NTIS CSCL 18/3

A computer code was developed for solving incompressible two-dimensional axisymmetric time-dependent viscous fluid flow problems involving up to two free surfaces. Heuristic models for turbulence are employed to extend the method to indefinitely high Reynolds number. Scalar quantities (heat and solute concentrations) are also followed, and the fluid may be slightly nonhomogeneous in the Boussinesq approximation. The method is a second-order space, forward time explicit finite-difference scheme. Free surfaces are treated using the MAC (Marker-and-Cell) technique. Author (TAB)

N70-41026*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.
THREE DIMENSIONAL ANALYSIS AND MEASUREMENT OF THE FLOW IN A THREE BLADED ROCKET PUMP INDUCER
A. Poncet and B. Lakshminarayana Jul. 1970 137 p refs
(Grant NGL-39-009-007)
(NASA-CR-72750; PSU-AERSP-70-1) Avail: NTIS CSCL 20D

Prediction of the three-dimensional inviscid flow in the inducer, with the exact equations of motion solved numerically, and approximate prediction of the flow at the inducer exit, using radial equilibrium and an empirical expression for the viscous losses, are discussed. The axial flow velocity perturbation due to radially varying blade blockage is investigated. A measuring technique was developed which uses hot wire probes to obtain the blade to blade variation of the three components of the velocity and turbulence at the three bladed inducer exit. A complete flow survey was carried out using a stationary probe at the exit of the inducer and a rotating probe inside the blade passage. The flow was visualized using an ammonia streak technique and a tuft grid to derive respectively the limiting streamline angles on the blade surfaces and the maximum radial inward flow at midpassage. The performance of the three bladed inducer is discussed thoroughly and compared with the performance of the four bladed inducer previously studied. Author

N70-41051# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
DETAILED ANALYSIS OF SIMILAR SOLUTIONS IN DISSOCIATIONAL NONEQUILIBRIUM NOZZLE FLOWS Final Scientific Report
N. Muniswamy Reddy and Fred L. Daum Mar. 1970 50 p refs
(AD-709193; ARL-70-0050) Avail: NTIS CSCL 20/4

The problem of obtaining similar solutions in pseudo-one-dimensional dissociational nonequilibrium nozzle flows is considered. The governing equations are transformed into a similar form. The governing equations are further reduced to a near-universal form by suitable transformation of the variables such that solutions for all combinations of initial conditions may be presented in a single graph. It is shown that the equilibrium solutions depend on only a single parameter, and the nonequilibrium solutions depend on two parameters, which are also the exact, general correlating parameters. With this approach, flow quantities can be readily determined without resorting to complex computer programs. Author (TAB)

N70-41054# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
THE CHARACTERISTICS OF A SMALL VARIABLE GEOMETRY EJECTOR Final Report
Brian Quinn Apr. 1970 47 p refs
(AD-709192; ARL-70-0071) Avail: NTIS CSCL 20/4

The characteristics of a variable geometry ejector were studied experimentally. Reorienting the ejector diffuser doors produced minor changes in the magnitude of the thrust vector while significantly changing its direction. The ejector was found to be an effective mass augmentor, entraining approximately 7 pounds of ambient air per pound of primary air. However, the developed thrust was found to fall around 25 percent short of the thrust produced by an isentropic expansion of the same primary mass. Experiments with the ejector confined within a cylindrical shell indicated no discernable change in the level of thrust although a two or three degree change in thrust direction was measured. This was attributed to the interaction flow field established within the confinement cylinder. Author (TAB)

N70-41166*# Bellcomm, Inc., Washington, D.C.
COMPUTATION OF THREE-DIMENSIONAL SUPERSONIC FLOWS WITH SHOCK WAVES
I. O. Bohachevsky 6 Aug. 1970 31 p refs
(Contract NASw-417)
(NASA-CR-113884; TM-70-1011-7) Avail: NTIS CSCL 20D

A simple numerical method for the computation of three-dimensional supersonic flows is described. The simplicity of the approach results from the use of a finite difference scheme that does not require a shock fitting procedure but permits a direct integration of the equations of motion in the axial direction. Application to nonsymmetric (at the angle of attack) conical flows is presented and compared with other solutions of the same problem and with experimental data. The idiosyncrasies of the technique are discussed, and a direction for further development of this approach is indicated. Author

N70-41185*# Hydronautics, Inc., Laurel, Md.
AN INVESTIGATION OF TANDEM ROW HIGH HEAD PUMP INDUCERS, PHASE 1 Interim Report
D. N. Contractor and R. J. Etter May 1969 125 p refs
(Contract NAS8-20625)
(NASA-CR-113890; TR-703-4) Avail: NTIS CSCL 20D

A theoretical and experimental investigation of tandem row high head pump inducers for rocket fuel pump applications was conducted. Stage 1 of the tandem set was designed to be supercavitating and used theoretical results for constant pressure cambered supercavitating cascades. The head distribution between stages was determined from a stability analysis predicting the conditions for incipient rotating stall. Stage 2 was designed using a technique which represented the blades of the inducer stage by radial line vortices, calculated the interference streamlines and used NACA thickness and camber distributions. The stages were empirically modified to improve performance. The best first and second stage were combined in tandem and tested at two overlaps. While not quite reaching the design goals, the experimental performance did indicate that the tandem inducer using a supercavitating first stage has definite potential as a high suction specific speed design concept. Author

N70-41201*# Southern Illinois Univ., Carbondale. Fluid Mechanics Research Lab.
STUDIES OF THE FLOW, BONDING AND DAMPING CHARACTERISTICS OF A SQUEEZE FILM UNDER DYNAMIC CONDITIONS Final Report, 15 Jun. 1968–31 Jun. 1970
Philip K. Davis 27 Jul. 1970 217 p refs
(Grant NGR-14-008-019)
(NASA-CR-66975) Avail: NTIS CSCL 20D

A series of experimental and computer investigations to learn more about the flow, bonding and damping characteristics of a liquid squeeze film under dynamic conditions are presented. The experiments and investigations were performed to determine: (1) the effect of viscosity on the bonding strength, general flow and flow during model break away. (2) the effect of film thickness on the bonding strength, general flow and flow during model break away. (3) the effect of load pulse duration on the bonding strength, general flow and flow during model break away. (4) the effect of film thickness on the damping characteristics of a mass undergoing low amplitude and low frequency vibrations, and (5) the effect of viscosity on the damping characteristics of a squeeze film. Author

N70-41338# Sandia Labs., Albuquerque, N.Mex.
UNSTEADY ONE DIMENSIONAL DIFFUSION IN A UNIFORM FLOW
S. J. Mulac and R. A. Hill Mar. 1970 25 p
(SC-DR-70-369) Avail: NTIS

An exact analytical solution for one-dimensional diffusion in a steady flow was obtained. The problem formulation and an analytical solution of the resulting partial differential equation are presented. Of primary concern is the initial surge of foreign gas into the steady flow, and the magnitude of the flow velocity required to minimize this surge. Author

N70-41642# Toronto Univ., (Ontario). Inst. for Aerospace Studies.
A NUMERICAL MODEL FOR A COMBUSTION-DRIVEN SPHERICAL IMPLOSION WAVE
A. Elsenaar Wright-Patterson AFB, Ohio ARL Apr. 1970 95 p refs
(Contract AF 33(615)-)5313)
(AD-709196; UTIAS-TN-144; ARL-70-0074) Avail: NTIS CSCL 14/2

A study is made of a combustion-driven spherical implosion wave inside a hemispherical cavity, using a finite difference method to integrate the one-dimensional Lagrangian gasdynamic equations, combined with an artificial pressure term to represent the shocks and a realistic equation of state for the stoichiometric hydrogen-oxygen mixture. The application of this technique is studied in some detail. TAB

N70-41697# Ling-Temco-Vought, Inc., Dallas, Tex. Research Center.
AN EXPERIMENTAL STUDY OF TURBULENT DIFFUSION OF DRAG-REDUCING POLYMER ADDITIVES Interim Report
R. R. Walters and C. S. Wells Apr. 1970 38 p refs
(Contract N00014-69-C-0214)
(AD-709455; Rept-0-71100/0R-14) Avail: NTIS CSCL 20/4

An experimental study of the mechanics of turbulent diffusion when uniformly injecting a drag-reducing polymer solution through a wall adjacent to a fully-developed pipe flow of water is described. Experimental diffusion data were obtained using very low injection rates in a porous wall pipe test section designed on the basis of a prior theoretical diffusion analysis with uniform injection. The drag-reducing effectiveness of the polymer only in the wall region, discovered previously, is substantiated by detailed concentration profile, velocity profile and wall shear stress data. These data indicate that an increase in the viscous sublayer thickness is accompanied by an increase in the diffusion sublayer thickness for uniform drag-reducing polymer injection. Also, uniform polymer injection at the wall appeared to somewhat inhibit the turbulent diffusion away from the wall. This type of injection provided drag reduction with a much smaller supply of polymer than required to raise the concentration throughout the shear layer to the same drag-reducing level. Author (TAB)

N70-41703# Brown Univ., Providence, R.I. Div. of Applied Mathematics.
LINEARIZED SECONDARY FLOW BETWEEN CONCENTRIC CYLINDERS WITH A NARROW ANNULUS
William A. Orth Mar. 1970 117 p refs
(Contract Nonr-562(42))
(AD-709435; TR-11) Avail: NTIS CSCL 20/4

A viscous incompressible fluid is contained in a narrow annular region between two concentric cylinders rotating at slightly different velocities. The annulus is bounded on tope and bottom by plates with angular velocities differing from either or both cylinder velocities. The solutions for the fluid velocity profiles are obtained from the linearized vorticity equations considered in the limit as the Ekman number vanishes. Four related problems are discussed in some depth. Author (TAB)

N70-41730# Indian National Scientific Documentation Centre, New Delhi.
SUSPENSION FACTOR IN TWO-PHASE STREAMS [FAKTOR VZVESHIVANIYA V DVUKHFAZNOM POTOKE]
A. K. Dyunin 1969 16 p refs Transl. into ENGLISH from Bul. Inst. Polytehnie (Bucharest), v. 12(16), no. 1-2, 1966 p 367-368
Supported by Dept. of Agr. and NSF
(TT69-53052) Avail: NTIS

A number of practical problems, for example, problems regarding pneumo- and hydrotransport, regulation of waterways, fight against sand storms, 'black' storms, snow storms etc. are related to the motion of two-phase streams. These problems must be solved on the basis of qualitative theory of two-phase stream which, up to this time, cannot be considered to be in good order. The main problem of this theory, viz. the basic cause of suspension of solid particles, is considered. Author (USGRDR)

N70-41763# Harry Diamond Labs., Washington, D.C.
FLUERICS 23: A BIBLIOGRAPHY
Apr. 1970 447 p refs Supersedes HDL-TR-1338
(AD-709497; HDL-TR-1495; HDL-TR-1338) Avail: NTIS CSCL 13/7

The bibliography of the literature in fluerics and fluidics technology contains approximately 629 citations of articles, books, and papers, and 399 descriptions of patents and disclosures. Titles of papers published in the proceedings of all major symposia of the last eight years are listed. Ket-Word-in-Context (KWIC) indexes of titles are used to allow ready access to all documents pertinent to a given subject. Author and inventor indexes are also provided. Introduction to the bibliography gives instructions for use and lists organizations from which information on fluidics and fluerics may be obtained. Author (TAB)

N70-41792# Lehigh Univ., Bethlehem, Pa. Dept. of Physics.
AN EXPERIMENTAL INVESTIGATION OF LAMINAR-TURBULENT TRANSITION IN FLOW THROUGH A RECTANGULAR PIPE Technical Report, 1966 - 1970
John A. Braslin (Ph.D. Thesis) 15 Jul. 1970 67 p refs
(Grants NSF GP-5393; NSF GP-10743)
(TR-22) Avail: NTIS

The laminar-turbulent transition in flow of air through a 0.95 × 10.32 cm rectangular pipe was studied experimentally using hot wire anemometers and photography of micron-sized oil drop tracers. Within a certain range of velocities, there are turbulent slugs in which the flow consists of alternating regions of laminar and turbulent fluid following each other down the pipe. With sharp edges breaking up the flow at the pipe entrance, measurements were made of the fraction of time the flow is turbulent at various flow speeds. The flow was intermittent in the range 2280 to 2760 Re and is turbulent half the time at Re = 2510. With a smooth entrance, supercritical laminar flow persists up to Re = 5100. Puffs of air injected through a hole in the pipe wall initiate single turbulent slugs in the supercritical flow, and velocities of the front and rear interfaces of these slugs were measured for 2400 to 4300 Re. All slugs grow if Re > 2700 and the higher the Re, the faster the growth. Details of the structure of the slugs are revealed by simultaneous recording of 4 hot wire responses. Author

13 GEOPHYSICS

Includes seronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N70-40413 Rice Univ., Houston, Tex.
INFLUENCE OF LAYER PARAMETERS ON LEAKING MODES
Arthur Frederick Woeber (Ph.D. Thesis) 1969 80 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-19341

Analytic derivatives of complex phase velocity with respect to layer parameters show that leaking modes on the (+ -) sheet are influenced by S velocities as well as P velocities. However, the pi pseudo modes, which make up the oscillatory portion of the seismogram between P and S, depend solely on P velocities. They thus provide information on P velocity distribution and in particular on a low velocity P channel. Dispersion curves for a modified CIT-IIGB model, which incorporates such a channel, are compared to curves from three Central American earthquakes. Tentative modifications, based on the derivatives, suggest a 50 km. thick layer centered at a depth of 100 km. with a P velocity about 0.25 km./sec. slower than in the layers above and below. Dissert. Abstr.

N70-40414 National Lending Library for Science and Technology, Boston Spa (England).
THE TEMPERATURE REGIME OF THE SOIL AT DIFFERENT DEPTHS UNDER A BARE SURFACE AND A NATURAL COVER
E. M. Rostokin 14 May 1970 17 p refs Transl. into ENGLISH from Ver. Volzhsk. Uprav. Gidromet. Sluzh. (Leningrad), no. 5, 1968 p 39-55
(NLL-M-9083-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl: 2 NLL photocopy coupons

A soil temperature test is described, which used thermometers at various depths from 0.2 to 3.2 m in two areas, one under a bare surface and one under natural cover. The test lasted over winters from 1961-62 to 1965-66. The two other parameters used were the cumulative sums of negative air temperatures, and the thickness of snow cover. It was found that frost penetrated more deeply into soil under a bare surface, and that the depth of frost correlates closely enough with the negative temperature sum to form a means of calculation. Author

N70-40440# Hawaii Inst. of Geophysics, Honolulu.
RESEARCH IN SEISMOLOGY RELATED TO THE COLUMBIA OCEAN-BOTTOM SEISMOGRAPH Final Report, 1 Nov. 1967 – 31 Aug. 1969
George H. Sutton, Mark E. Odegard, Norman Mark, and Nelson J. Letourneau 30 Sep. 1969 73 p refs
(Contract F19628-68-C-0083; ARPA Order 292)
(AD-708518; HIG-70-12; AFCRL-70-0125) Avail: NTIS CSCL 8/11

The report contains results of research conducted on data from the Columbia Ocean-Bottom Seismograph. The report describes the history of the ocean-bottom seismograph, the location and instrumentation of OBS-III, the nature of research conducted under this contract and the personnel associated with the contract. The report also outlines results of research in the areas of spectral and correlation analysis, local earthquake studies, particle motion studies, detection ability studies, construction of a station log of events, microseism analysis and studies of interesting arrivals in local earthquake wave trains. Suggestions for further research related to an ocean-bottom seismograph are also discussed. Author (TAB)

N70-40463# Institute for Storm Research, Inc., Houston, Tex.
MESOSCALE INPUTS TO MICROSCALE MODELING OF THE ATMOSPHERE Final Report, Jan. 1969 – Jan. 1970
John C. Freeman, Jr., Li Peng, Sam B. Rosenberg, Peter W. Sloss and Leon F. Graves Fort Huachuca, Ariz. ECOM Jan. 1970 34 p refs
(Contract DAEA18-69-C-0073)
(AD-708575; ISR-9-3; ECOM-0073-F) Avail: NTIS CSCL 4/1

A previously developed model of mesoscale flow has been modified to include a microscale input in the form of a velocity profile with directional changes in the wind velocity in the profile. The modifications of the microscale model which develop its profile are indicated. In particular, Ohmstedes (1966) model of wind moisture and temperature is modified. Author (TAB)

N70-40520# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
CHARACTERISTICS OF THE GEOPHYSICAL FIELDS IN THE TERRITORY OF THE USSR [KHARAKTERISTIKA GEOFIZICHESKIKH POLEI TERRITORII SSSR]
N. M. Soloveva et al Jan. 1970 56 p refs Transl. into ENGLISH from the publ. 'Geologicheskoye Stroyeniye SSSR. Vol. 2: Tektonika' Moscow, Nedra Publishers, 1968 p 15 – 52
(AD-708433; ACIC-TR-1605) Avail: NTIS CSCL 8/7

At present, on account of its irregular exploration, it is not possible to give a full description of the anomalous field on the territory of the Soviet Union; therefore the geological conclusions are in many cases only preliminary. The geothermal field is closely associated with other geophysical fields, with the characteristics of tectonic development in different sections of the earths crust, etc. All this calls for detailed studies of the thermal conditions in the interior part of the earth, within the range accessible to direct geothermal measurements. Since drill holes are not proportionally distributed, knowledge of the geothermal conditions on the territory of the Soviet Union remains spotty. Author (TAB)

N70-40539# Army Coastal Engineering Research Center, Washington, D.C.
RAPLOT, A COMPUTER PROGRAM FOR DATA PROCESSING AND GRAPHICAL DISPLAY FOR RADIOISOTOPIC SAND TRACER STUDY
Philip A. Turner May 1970 69 p refs
(AD-708556; MP-3-70) Avail: NTIS CSCL 9/2

RAPLOT II is a computer program for processing radiation and navigation data from field surveys of the Radioisotopic Sand Tracer (RIST) study, but is applicable to any survey type operation on the nearshore Continental Shelf. Collected data are punched onto paper tape by the data collection computer on the research vessel. The data are later transferred to magnetic tape which provides the input for the RAPLOT II Program. Program control parameters are on punched cards. The navigation data, which consists of ranges to two shore-based radar beacons, are first edited for spurious data, and then converted to rectangular coordinates (in this case the California Lambert Coordinate System). Radiation data are converted to count rate as counts per second. Background count rate is computed and subtracted from the observed count rate, and any radiation counts that are significantly above the background count rate are corrected for time of decay since the isotope was injected. Output from the program is in three forms - printed output, graphical output, and magnetic tape record. The processed data are transferred to magnetic tape and made available for further processing such as the generation of contour maps. Author (TAB)

N70-40607 Rice Univ., Houston, Tex.
LONG PERIOD LEAKING MODES
Michael David Cochran (Ph.D. Thesis) 1969 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-19276

Dunkin's method is used to compute the dispersion curves of leaking modes on both the (+ –) and the (– –) sheets of a continental model of the crust and upper mantle containing a low velocity P- and S-channel. The Pi-- and Sigma-- modes are little affected by the presence of the channel. The dispersion curves of Pi and Sigma modes on the (+ –) sheet combine to form two families of almost continuous curves. The first, called Pi pseudo-modes, is formed by plateaus in the curves; it has high group velocities and low attenuation; at higher frequencies it corresponds partly to channel waves. The second, or Sigma pseudo-modes, is formed by the slopes; it has low group velocities and high attenuation. Harkrider's modification of the Haskell-Thomson matrix formulation has been extended to the computation of surface excitation functions of leaking modes for a source located in the waveguide. An increase of source depth increases the amplitudes of the excitation function of the fundamental modes on both sheets; this relationship is more complicated for higher modes. Dissert. Abstr.

N70-40634 National Lending Library for Science and Technology, Boston Spa (England).
A STUDY OF THE RELATION BETWEEN SOLAR ACTIVITY AND THE POTENTIAL GRADIENT OF THE ELECTRIC FIELD IN THE ATMOSPHERE AS GIVEN BY MATERIAL FROM STATIONS IN THE SOVIET UNION IN 1957 – 1967
N. A. Paramonov 29 May 1970 7 p refs Transl. into ENGLISH from Tr. Gl. Geofiz Obs. (Leningrad), no. 242, 1969 p 125 – 129
(NLL-M-9123-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Annual mean potential gradients were compared with solar activity from 1957 to 1967 at all stations. The observations were made by the collector method, using apparatus with a radioactive collector. The results show a parallel variation in the potential gradient and Wolf number curves. The potential gradient was greater during sunspot maxima than during periods of minima. Large deviations of the potential gradient from its mean value for all days were related to local phenomena. R.B.

N70-40636# Ionospharen-Institut Braisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131 [IONOSPHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131
Jun. 1970 44 p ref In GERMAN and ENGLISH
(Rept-288F) Avail: NTIS

Daily summaries are presented for vertical echo sounding of the upper atmosphere over Freiburg, Germany during June 1970. The data include charts of median values for the E and F regions, MUF(3000)F2, M(3000)F2, h'F2, hpF2, foF1, MUF(3000)F1, M(3000)F1, h'F, foE, foE2, h'E, foEs, fbEs, h'Es, Type Es, foT, and fmin values. R.B.

N70-40646# Air Force Cambridge Research Labs., Bedford, Mass.
THE MAGNETIC CONTROL OF GLOBAL PATTERNS OF F-LAYER VERTICAL DRIFT CAUSED BY NEUTRAL WINDS
C. P. Pike May 1970 14 p refs *Its* Environ. Res. Papers No. 321
(AD-707822; AFCRL-70-0275) Avail: NTIS CSCL 4/1

Basic considerations to a study of F-layer modification by vertical drift from any postulated neutral atmospheric wind system are the effects of local magnetic inclination and declination upon the resulting F-layer vertical drift velocity. The effect of local magnetic inclination enters in the term sin I cos I contained in the expression for the vertical drift velocity Vz = V sin I cos I, where V is the wind velocity in the horizontal plane. A global map with contours of sin I cos I is presented in the report which enables one to compare the effect of inclination in different regions. This map shows where inclination would either tend to null or to maximize F-layer vertical drift respectively. The global maps clearly show that vertical drift is often strongly nonsymmetric at magnetic conjugate locations. Finally, an understanding of F-layer structure and dynamics is particularly important in many radio propagation problems. Author (TAB)

N70-40671# Boston Univ., Mass. Dept. of Physics and Astronomy.
A MODEL RELATING THE RADIAL CHANGES OF THE PLASMAPAUSE AT DUSK TO GEOMAGNETIC ACTIVITY
Michael Mendillo and Michael D. Papagiannis Apr. 1970 19 p refs
(Contract F19628-68-C-0097)
(AD-708495; AFCRL-70-0257; SR-2) Avail: NTIS CSCL 4/1

The theory of magnetospheric convection is reviewed with special attention paid to the dusk sector. A model is presented which relates the dawn-dusk electric field, which drives the convection, to the square of the solar wind speed. Assuming that the plasmapause is located at the equatorial distance where the dawn-dusk electric field cancels the electric field due to the rotation of the earth, we were able to compute the changes of the plasmapause for various values of solar wind speed. Furthermore, using a previously obtained empirical relation between the solar wind speed and the geomagnetic index Kp, we have plotted the equatorial radius of the plasmapause in the dusk sector vs. the Kp index. Extrapolating along L-shells to ionospheric heights, the predictions of this model are found to be in good agreement with a statistical relation between Kp and the invariant latitude of the ionospheric trough. Author (TAB)

N70-40675# Boston Univ., Mass. Dept. of Physics and Astronomy.
THE INFLUENCE OF THE NEUTRAL WINDS IN THE FORMATION AND DISTRIBUTION OF THE IONOSPHERIC EVENING ANOMALY
Henry Mullaney and Michael D. Papagiannis Jun. 1970 19 p refs
(Contract F19628-68-C-0097)
(AD-708496; AFCRL-70-2063; SR-3) Avail: NTIS CSCL 4/1

By plotting world contour maps of the index which describes the magnitude of the evening anomaly (the higher than expected evening values of the critical ionospheric frequency in the summer hemisphere), we have obtained patterns which show that the anomaly is more pronounced in regions of westward declination in the northern hemisphere and eastward declination in the southern hemisphere, as well as in regions where there is a poleward divergence of the magnetic meridians. By studying neutral wind patterns computed by other authors, we have reached the conclusion that the neutral winds, by dragging the ionospheric plasma which is essentially constrained to move along the lines of force of the earths magnetic field, play a very important role in determining the geographic variations in the intensity of the evening anomaly. Author (TAB)

N70-40723# Joint Publications Research Service, Washington, D.C.
OCEANOGRAPHY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 236 11 Sep. 1970 p 17-20 refs (See N70-40721 23-34)
Avail: NTIS

Magnetic, gravimetric, and depth-sounding surveys of relief, geological structure, and deep structure of the crust and upper mantle in the rift zones of the Mid-Atlantic Ridge are reported. Seismic soundings, thickness determination of sedimentary deposits, anf heat flux measurements are also noted. Instrumentation for measuring current velocity fluctuations is described. Airborne electronic equipment is discussed for use in measuring ocean surface temperature to establish paths of mackerel and saury fish. Abstracts on various oceanographic literature are also included. J.A.M.

N70-40724# Joint Publications Research Service, Washington, D.C.
TERRESTRIAL GEOPHYSICS
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 236 11 Sep. 1970 p 21-23 refs (See N70-40721 23-34)
Avail: NTIS

Seismic oscillation effects on permanently frozen ground depending on stratum strength, temperature, and ice or water impregnation are studied. Seismometers for intensity measurements of earthquakes and underground tremors are being distributed to 40 ground stations. Abstracts on various geophysical literature are also included. J.A.M.

N70-40739# National Academy of Sciences-National Research Council, Washington, D.C.
THE LAND OF NESTOR: A PHYSICAL GEOGRAPHY OF THE SOUTHWEST PELOPHONNESE
William G. Loy [1970] 187 p refs
(Contract N00014-67-A-0244-0001)
(AD-708419) Avail: NTIS CSCL 8/6

This study attempts to reconstruct the Late Bronze Age landscape of the southwest Peloponnese by determining the modern distributions of these physical patterns, investigating the processes that have changed them over the past three millennia, and applying these changes to the modern distribution in order to arrive at an estimate of the Late Bronze Age conditions. The basic physical patterns of landscape have been studied in a systematic fashion, hitherto impossible, through the agency of relatively large-scale stereographic aerial photographs. In every phase of the work, aerial-photo interpretation has been supplemented by the study of topographic and distribution maps, the use of diverse archival materials, extensive field checking, and a wide range of field techniques. Author (TAB)

N70-40772*# Virginia Inst. of Marine Science, Gloucester Point.
PRIORITY PROBLEMS AND DATA NEEDS IN COASTAL ZONE OCEANOGRAPHY. EARTH OBSERVATION SATELLITE PLANNING
John C. Mundy, Jr., Edwin B. Joseph, Robert J. Byrne, John L. Dupuy, Thomas D. Wright et al Sep. 1970 138 p refs
(Contract NAS1-9461)
(NASA-CR-111779) Avail: NTIS CSCL 08I

Coastal zone oceanographic problems and data needs have been defined for an oceanographic satellite. Problems are based on national and coastal zone priorities. Descriptions of the problems discuss the data needs and the expected utility of remote measurement. Data needs and resolution requirements are specified for surface and satellite measurement. Remote measurables are numerically ranked and evaluated. An experiment in coastal zone oceanography is proposed for ERTS A. Coordination of the ERTS program with IDOE is discussed. Author

N70-40794# Coast Guard, Washington, D.C. Oceanographic Unit.

OCEANOGRAPHIC OBSERVATIONS NORTH PACIFIC OCEAN STATION NOVEMBER 30 deg 00 min N., 140 deg 00 min W. MARCH 1967 – MARCH 1968

David M. Husby Sep. 1969 200 p refs

(CG-373-26; Rept-26) Avail: NTIS

This report contains the observed and interpolated temperature and salinity data plus the computed sigma-t, geopotential anomalies and sound velocities for 195 oceanographic stations. Daily casts of 13 – 14 Nansen bottles were made to a depth of 1500 meters when weather conditions permitted. In addition, sampling was successfully extended to near the bottom on at least one station during each patrol. Author

N70-40812*# Old Dominion Coll., Norfolk, Va.

A SURVEY OF THE PROBLEMS AND RESEARCH NEEDS IN THE COASTAL ZONE

William J. Hanna, Harold G. Marshall, James F. Slowey, eds. 15 Sep. 1970 109 p refs

(Contract NAS1-9434)

(NASA-CR-111780) Avail: NTIS CSCL 08J

The major problems and research needs in coastal zone oceanography are presented for the individual disciplines of biology, chemistry, geology, and physics, including zone meteorology. Among coastal zone problems highest priority is assigned to pollution. The greatest need was found to be acquisition of more physical data for improving our knowledge of coastal water mixing processes. Required ground truth measurements and possible application of Earth Resources Satellite sensory data for solution of specific problems are given. Special emphasis is given to those problems and needs of an interdisciplinary nature. E.M.C.

N70-40828# Joint Publications Research Service, Washington, D.C.

FIRST UNDERWATER RESEARCH VESSEL DESCRIBED

Yordan Aleksandrov *In its* Transl. on Eastern Europe Sci. Affairs, No. 130 9 Sep. 1970 p 6 – 7 Transl. into ENGLISH from Otechestven Front (Sofia), 23 Aug. 1970 p 6 (See N70-40826 23-34)

Avail: NTIS

An underwater research vessel was developed in Bulgaria; it is briefly described, including the various compartments, laboratory equipment, and exterior design. A question and answer session with the director of the Bulgarian oceanographic institute is also presented. J.A.M.

N70-40878*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

TERRESTRIAL SPACE

In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 31 p refs (See N70-40876 23-30)

Avail: NTIS CSCL 04A

Terrestrial space is defined as the region between 90 and 65,000 km above the surface of the earth for all environment components except meteoroids, where the outer limit of the earth's sphere of influence extends into space until the gravitational attraction becomes negligible. Information is provided concerning gas properties, ionosphere, radiation environment, meteoroid environment, geomagnetic environment, and astrodynamic constants. P.A.B.

N70-40880*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

COMPUTATIONAL PROCEDURE USED IN THE DEVELOPMENT OF THE MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967)

In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 11 p refs (See N70-40876 23-30)

Avail: NTIS CSCL 04A

The procedure is outlined from input to output, including computations for the sun's declination and hour angle, the exospheric temperature and the temperature at geometric altitude levels, the number density of hydrogen, helium, molecular nitrogen, and molecular and atomic oxygen, total number density, mass density, molecular weight, and atmospheric scale height. P.A.B.

N70-40891*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A PRELIMINARY SUMMARY OF THE MSFC PLANETARY ATMOSPHERE COMPUTER PROGRAM

In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 9 p (See N70-40876 23-30)

Avail: NTIS CSCL 04A

The computational procedure used in the program is outlined. Basic data necessary for developing model atmospheres are said to be kinetic temperature and molecular weight versus geopotential height profiles and a surface pressure. The various parameters are printed out in tabular form for km increments of both geopotential height and geometric altitude. The accuracy and versatility of the program, which is designed to allow computations from the planet's surface to interplanetary space altitude levels, are discussed. P.A.B.

N70-40933# National Environmental Satellite Center, Washington, D.C.

AIRCRAFT MICROWAVE MEASUREMENTS OF THE ARCTIC ICE PACK

Alan E. Strong and Michael H. Fleming Aug. 1970 19 p refs Presented at 51st Ann. Meeting of the Am. Geophys. Union, Washington, D.C., 20 – 24 Apr. 1970

(ESSA-TM-NESCTM-25) Avail: NTIS

Microwave radiometer data taken from an aircraft mission over the Arctic Ocean near Point Barrow, Alaska, are examined. The microwave brightness temperatures corresponding to varying ice pack conditions are correlated with simultaneous photography and infrared radiation data. Microwave measurements of the surface taken both through and from beneath a stratus cloudcover are investigated for atmospheric attenuation and emission effects. The influence of clouds is greatest when viewing surfaces such as water, which appears cold at microwave frequencies because of its low emissivity. In general, cloudiness diminishes the capability of the 19.3-GHz radiometer to discriminate between ice and water. Polynya and other openings in the ice pack display a characteristic brightness temperature near 100 K when viewed through a cloud-free atmosphere, whereas they appear as much as 20 to 40 K warmer when clouds intervene between the surface and the radiometer. Author

N70-40941# Naval Oceanographic Office, Washington, D.C.

LONG-TERM FLUCTUATIONS OF HEAT BALANCE ITEMS IN BARENTS AND NORWEGIAN SEAS [MNOGOLETNIE KOLEBANIYA KOMPONENTOV TEPLOVOGO BALANSA BARENTSEVA I NORVEZHSKOGO MOREI]

Ye. I. Seryakov 1970 19 p refs Transl. into ENGLISH from PINRO (Murmansk), v. 11, 1968 p 121 – 133 refs

(AD-709131; NOO-Trans-499) Avail: NTIS CSCL 8/10

This report is designed to summarize the work of many years that has been carried out by a small group of oceanologists of the LGMI which studied the heat balance of Barents and Norwegian Seas. Author (TAB)

N70-40978*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.

TABLES FROM THE PENN STATE MARK 1 IONOSPHERIC

MODEL
John S. Nisbet 20 Aug. 1970 174 p refs
(Grant NGL-39-009-003)
(NASA-CR-113799; SR-362(E)) Avail: NTIS CSCL 04A

The models have as variables the latitude and longitude, the day number, the time and the 2800 MHz (10.7 cm) solar flux. The tables are given for east longitudes of 0 deg, 90 deg, 180 deg and 270 deg and latitudes from −60 deg to +60 deg in 20 deg increments. Models are given for the summer and winter solstice and the spring equinox. Values are given of the electron density from 120 km to 1250 km, the electron content in a one square centimeter vertical column from 120 to 1250 km, the F2 peak electron density N sub m F2 in units of 1/cu cm, and the altitude of the F2 peak in km, H sub m F2. Three parameters of midlatitude sporadic E, the percentage probability of observing sporadic E with a critical frequency greater than 0.5 MHz, the average value of the peak electron density when it is observed, and the standard deviation of the lognormal distribution are given. The model is a computer program and the tables presented are representative print outs. Author

N70-40991# Lockheed Missiles and Space Co., Palo Alto, Calif. Space Sciences Lab.
A COORDINATED EXPERIMENT ON RADAR CLUTTER AND AURORAL PARTICLE FLUXES Final Report, 27 Jan. – 28 Nov. 1969
G. B. Shook 30 Apr. 1970 16 p refs
(Contract N00014-69-C-0207)
(AD-709105; LMSC/N-6P-70-1) Avail: NTIS CSCL 4/1

A series of coordinated experiments has been performed, consisting of simultaneous radar echo and auroral particle flux measurements over Alaska. The radar data were obtained by Stanford Research Institute, based at Homer, Alaska; the particle flux data were obtained from the Lockheed group of instruments aboard the polar-orbiting satellite OV1-18, during the spring and fall of 1969. Both radar and satellite data are of good to excellent quality, and general agreement is observed between location and intensity of radar echoes and the precipitating particles producing the aurora. Detailed analysis (not a part of this work) appears worthwhile to determine a characteristic signature for radar returns from aurora, as distinguished from solid body returns. Author (TAB)

N70-41028*# Geological Survey, Washington, D.C.
GEOLOGIC INVESTIGATIONS OF REMOTE SENSING TECHNIQUES Final Report, FY 1966
W. D. Crater 21 Jul. 1966 21 p refs *Its* Tech. Latt. No. 52
(NASA Order R-09-020-011; NASA Order R-09-020-013; NASA Order R-09-020-015; NASA Order R-09-020-019)
(NASA-CR-76634) Avail: NTIS CSCL 08G

The administration, funding manpower, and report accomplishments for the year are reviewed. The types of investigations undertaken are described, including instrument design and feasibility studies, space data studies, field investigations, and coordination and evaluation of remote sensing techniques. Significant scientific results are reported in the areas of Nimbus infrared imagery, space photography, radar imagery, infrared investigations, and ultraviolet absorption and stimulated luminescence. General plans and recommendations are enumerated for FY 1967; a list of reports completed during FY 1966 is included. P.A.B.

N70-41042*# Massachusetts Inst. of Tech., Cambridge. Measurement Systems Lab.
ROTATION INVARIANT PROBABILITY DISTRIBUTIONS IN GEODESY
Ronald Murray Hirschorn (M.S. Thesis) 4 Jun. 1970 80 p refs
(Grant NGL-22-009-262)
(NASA-CR-113811; TE-41) Avail: NTIS CSCL 08E

Gravity anomalies are treated as a stationary random process defined on the surface of a sphere. Certain linear transforms of gravity anomalies on the surface (Poisson's integral and Stokes' formula) which give gravity anomalies and anomalous potential above the surface are examined. It is shown that certain statistics (covariance functions) for gravity anomalies and anomalous potential above the surface of the sphere can be obtained from the covariance function of gravity anomalies on the surface. These statistics are calculated for various models of covariance functions of gravity anomalies on the surface. The covariance function for anomalous potential obtained (using Stokes' formula) from a covariance function derived from actual measurements of gravity anomalies on the surface is compared with the covariance function for anomalous potential resulting from observations of satellite motion. The close agreement between these two covariance functions is used to justify treating gravity anomalies as a rotation invariant random process. Author

N70-41047*# Informatics Tisco, Inc., College Park, Md.
REMOTE SENSING OF EARTH RESOURCES. A LITERATURE SURVEY WITH INDEXES
Washington NASA 1970 1220 p Sponsored by NASA
(NASA-SP-7036) Avail: NTIS HC$10.00/MF$0.65 CSCL 08F

This literature survey lists 3684 reports, articles, and other documents introduced into the NASA scientific and technical information system between January 1962 and February 1970. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, oceanography and marine resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis. Author

N70-41063*# Oregon State Univ., Corvallis. Dept. of Range Management.
REMOTE SENSING APPLICATIONS IN FORESTRY: INVENTORY OF NATIVE VEGETATION AND RELATED RESOURCES FROM SPACE PHOTOGRAPHY Annual Progress Report
Charles E. Poulton, Edmundo Garcia-Moya, James R. Johnson, and Barry J. Schrumpf Berkeley, Calif. Calif. Univ. 30 Sep. 1969 74 p refs Prepared in cooperation with Calif. Univ., Berkeley and Dept. of Agr. Forest Serv.
(NASA Order W-12996)
(NASA-CR-113805) Avail: NTIS CSCL 02F

Progress reported in a program of continuing research includes: (1) ground-truth support for the Apollo 9 mission and the S065 and high-flight experiments; (2) acquisition of specialized ground-truth and preliminary evaluation of multiseasonal photography as an aid to vegetation interpretation; (3) development and testing of a symbolic legend concept for use in photo interpretation and the annotation of mapped delineations; (4) initial field work on development of an ecological ground-truth classification that is essential to detailed, quantitative, image-relationship studies and to legend refinement at levels required in vegetational management decisions; and (5) demonstration of the feasibility of vegetational resource analysis by aerial photography subsampling at various scales from initial stratifications on space photography. This latter step permits the complete, quantitative characterization of space-photo images of naturally vegetated landscapes. Author

N70-41064*# California Univ., Berkeley. Forestry Remote Sensing Lab.
REMOTE SENSING APPLICATIONS IN FORESTRY. THE IDENTIFICATION AND QUANTIFICATION OF HERBLAND AND SHRUBLAND VEGETATION RESOURCES FROM AERIAL AND SPACE PHOTOGRAPHY Annual Progress Report
Richard S. Driscoll (Rocky Mt. Forest and Range Expt. Station) 30 Sep. 1969 60 p refs Prepared in cooperation with Dept. of Agr.

(NASA Order W-12-996)
(NASA-CR-113802) Avail: NTIS CSCL 08F

Research is reported in a program to assess the merits of large-scale color and infrared color aerial photography for detecting and identifying herbaceous and shrubby plant species and communities at four test locations in Colorado. Added emphasis was placed on multistaged sampling techniques to quantify earth resources photography from space using Apollo 9 color infrared photographs of an area around Roswell, New Mexico, for base data. A multiple sampling technique involving subsampling is described whereby color infrared aerial photos at scales of 1:80,000, 1:20,000, and 1:2,400 are used to estimate the areal extent of the specific plant communities and to estimate specific plant species density. A photointerpretation key for shrubs was developed to compare film type and photoscale for identification of individual shrubs. Image characteristics used were class categories of crown shape, crown margin, foliage texture, foliage pattern, plant size, shadow, and color. Author

N70-41074*# Geological Survey, Washington, D.C.
USE OF INFRARED IMAGERY IN STUDY OF THE SAN ANDREAS FAULT SYSTEM, CALIFORNIA
R. W. Wallace and R. M. Moxham Jun. 1966 23 p *Its* Tech. Letter NASA-42
(NASA Order R-09-020-015)
(NASA-CR-76707) Avail: NTIS CSCL 08G

Infrared imagery in the 8 to 13 micron band obtained from aircraft overflights in June 1965 is being used to study the San Andreas fault system in the Carrizo Plain area of California. The fault trace shows clearly over most of the approximately 200-mile length that was flown. Variations in soil moisture caused by the water-barrier characteristics of the fault zone, as well as vegetation differences related to soil moisture and microtopography are factors influencing visibility of the fault in the infrared imagery. Other features that can be identified on the imagery, and which are useful in analyzing offset on the San Andreas fault include: offset segments of ancient stream channels disrupted by movement on the fault, landslide terrain, and numerous soil and Tertiary bedrock units. A Pliocene shale, for example, shows a relatively cool surface as compared to adjacent and nearby bodies of the Santa Margarita Formation and the upper Monterey Shale. Imagery obtained one to two hours before sunrise is considered most useful for the fault studies. Author

N70-41075*# Geological Survey, Washington, D.C.
POTENTIAL TIME-COST BENEFITS FROM USE OF ORBITAL-HEIGHT PHOTOGRAPHIC DATA IN CARTOGRAPHIC PROGRAMS
Lowell E. Starr and Winston Sibert Aug. 1966 23 p refs *Its* Tech. Letter NASA-54
(NASA Order R-09-020-024)
(NASA-CR-77069) Avail: NTIS CSCL 08B

The advantages and applications of civilian use of orbital remote sensing data, especially photographic data, in the cartographic field are discussed. Monetary benefits derived from use of topographic maps are described, and estimates of direct dollar benefits annually resulting from availability of useful orbital-height photographic data are presented. Global considerations focus on the comparative cost of data collection and the current status of aerial photographic coverage and world mapping. The prime value of orbital photographic systems is its capability to collect data on a national and global basis within a time frame and with a coverage per data-bit at significant cost savings and increased production rates. S.P.

N70-41106*# Southwest Center for Advanced Studies, Dallas, Tex. Geosciences Div.
MAGNETIC REVERSALS: THEIR APPLICATION TO STRATIGRAPHIC PROBLEMS
Peter J. Burek [1970] 34 p refs
(Grant NGL-44-004-001)
(NASA-CR-113859) Avail: NTIS CSCL 08G

Paleomagnetic results from Europe and North America show that the Lower Triassic is characterized by mixed polarity, quite in contrast to the long lasting reversed Kiaman Interval of the Permian. These pronounced differences emphasize the application possibilities of paleomagnetism to stratigraphical boundary problems, in this case definition of the Paleo-Mesozoic boundary. A paleomagnetic study of the uppermost part of the Middle and Upper Buntsandstein (Scythian), showed that several magnetic reversals provide the same correlation as do fossil soils over a distance of about 200 km. This example is used to demonstrate the importance of magnetic reversals as stratigraphical auxiliary tool for regional problems. Author

N70-41107*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MULTISPECTRAL REMOTE SENSING OF AN EXPOSED VOLCANIC PROVINCE
J. G. Quade (Nevada Univ.), P. E. Chapman (Nevada Univ.), P. A. Brennan (Nevada Univ.), and J. C. Blinn, III 15 Jun. 1970 43 p refs
(Contract NAS7-100)
(NASA-CR-113826; JPL-TM-33-453) Avail: NTIS CSCL 08G

During July of 1968 a mission was flown, for a second year, over a volcanic province at Mt. Lassen National Park, in support of the NASA Earth Resources Program. Day and night flights were completed with the following instruments operating satisfactorily: two 9-in. by 9-in. metric cameras with black and white and color IR film, an 8– 14 micrometer IR scanner, four microwave radiometers operating at 8.9, 15.8, 22.2, and 34.0 GHz and a 13.3-GHz radar scatterometer. Four ground stations were manned during the flights to monitor ground temperatures and moistures. These data were used in conjunction with ground-based radiometers operating at 1.4, 9.3, 13.7, and 37.0 GHz. Prior to the overflights, extensive ground studies (terrametrics), utilizing standard geologic and geophysical techniques, were performed. Data from the aircraft and ground-based sensors are presented with the relative merits of each sensor discussed along with recommendations for their application. Author

N70-41112*# Geological Survey, Washington, D.C.
ANALYSIS OF EARTH ORBITER TEST SITE PROGRAM IN RELATION TO US MINERAL NEEDS
W. D. Carter Aug. 1966 21 p *Its* Tech. Letter NASA No. 59
(NASA Order R-09-020-013)
(NASA-CR-77747) Avail: NTIS CSCL 08G

The objectives, scope, and results of the current NASA Earth Resources Program, specifically its Test Site Feasibility Program, are analyzed in relation to the nation's needs for mineral resources. A list of the mineral commodities in critical shortage was developed and is compared with a list of sites presently under investigation. Author

N70-41115*# Geological Survey, Washington, D.C.
GEOLOGIC INTERPRETATION OF THE GEMINI 5 PHOTOGRAPH OF THE SALT RANGE-POTWAR PLATEAU REGION, WEST PAKISTAN
William R. Hemphill and Walter Danilchik Aug. 1966 22 p *Its* Tech. Letter NASA-40
(NASA Order R-146-09-020-006)
(NASA-CR-77597) Avail: NTIS CSCL 08G

A photograph of the Salt Range and Potwar Plateau region of West Pakistan, taken during the Gemini 5 mission, was evaluated to determine the range of geological and geographic features which can be interpreted from a solitary photograph with a minimum of foreknowledge. The field of view covers about 7000 square miles. The structural features and lithologic information are discussed. It is concluded that some geologic features are more readily recognized and interpreted from a single photograph taken from orbital altitudes than on conventional aerial photographs of larger scale where hundreds of prints are required. Folds and faults were

delineated on the basis of rock outcrop pattern, color or tone, and drainage pattern. Some stratigraphic relationships were also recognized, but specific rock type identification was less conclusive and reliable. N.E.N.

N70-41116*# Geological Survey, Washington, D.C.
PRELIMINARY ULTRAVIOLET REFLECTANCE OF SOME ROCKS AND MINERALS FROM 2000 ANGSTROM TO 3000 ANGSTROM
A. N. Thorpe, C. M. Alexander, and F. E. Senftle Aug. 1966 52 p ref *Its* Tech. Letter NASA-37
(NASA Order R-146-09-020-006)
(NASA-CR-77596) Avail: NTIS CSCL 08G

Initial measurements of solar reflectance to determine the composition of rocks are reported. The rock and mineral specimens were sawed, and one face was cut and polished. Reflectance measurements were made on a 1/2 meter, grating type, McPherson spectrophotometer. A sharp attenuation of reflectance was found in the neighborhood of 1900 A, and was attributed to the presence of oxygen, mainly in the form of SiO_2. Minerals containing no oxygen showed no such drop. Graphs of the measurements for each specimen are included. N.E.N.

N70-41117*# Geological Survey, Washington, D.C.
GEOLOGICAL EVALUATION OF NIMBUS VIDICON PHOTOGRAPHY, CHESAPEAKE BAY-BLUE RIDGE
Charles R. Lewis and William E. Davies Nov. 1966 11 p ref *Its* Tech. Letter NASA-64
(NASA Order R-09-020-011)
(NASA-CR-80783) Avail: NTIS CSCL 08G

Vidicon photograph 36N284, at a scale of about 1:2,800,000, shows a Mercator effect of scale distortion north and south of the center of the picture. No distinct cultural features can be discerned. Haze and vegetation patterns are dominant. Rocks reflected by vegetation changes can be identified. These include ridges of folded quartzites, the Blue Ridge Complex, and Triassic fault blocks. Deep soils in both the Piedmont and Coastal Plain make it impossible to distinguish the rocks of these areas. Author

N70-41121*# Geological Survey, Flagstaff, Ariz.
RADAR IMAGES: METEOR CRATER, ARIZONA
Gerald G. Schaber Washington Nov. 1966 18 p refs *Its* Tech. Letter NASA-62
(NASA Order R-09-020-015)
(NASA-CR-80642) Avail: NTIS CSCL 08G

Two overlapping strips of radar imagery, covering a total combined area of 460 square miles, centered on Meteor Crater, Arizona, were obtained. The system was a high frequency (K-band), side-looking radar with a multipolarization capability. Two images were recorded simultaneously on each strip. Two separate combinations of transmit and receive polarizations were used for the two flight lines. In Run No. 8, the upper image was produced from the horizontal component of a horizontally transmitted wave; the lower cross polarized image from the vertical component of a horizontally transmitted wave. In Run No. 14, the upper image was produced from the vertical component of a vertically transmitted wave, the lower image was produced from the horizontal component of a vertically transmitted wave. Author

N70-41122*# Geological Survey, Menlo Park, Calif.
EVALUATION OF RADAR IMAGERY OF HIGHLY FAULTED VOLCANIC TERRANE IN SOUTHEAST OREGON
G. W. Walker May 1966 15 p refs *Its* Tech. Letter NASA-25
(NASA Order R-09-020-015)
(NASA-CR-75507) Avail: NTIS CSCL 08G

The synoptic view afforded by the radar image of southeast Oregon is useful in tracing regional structures reflected by topography. Geologic features are generally more apparent on the high contrast polarized image, although several cultural features are more clearly delineated on the depolarized image. Comparison of the radar image with conventional high altitude photographs of the same area indicates that the photographs supply considerably more complete and detailed geologic information than does the radar image, perhaps partly because of the appreciable scale difference. Author

N70-41123*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EKTACHROME AND EKTACHROME PHOTOGRAPHY OF THE TWIN BUTTES AREA, ARIZONA
John R. Cooper (US Geol. Surv., Denver, Colo.) Jan. 1968 14 p Prepared by US Geol. Surv., Denver *Its* Tech. Letter No. 89
(NASA Order R-09-020-011)
(NASA-TM-X-60760) Avail: NTIS CSCL 08G

Ektachrome and Ektachrome infrared photography of the Twin Buttes area, Arizona (Test Site No. 15) was exposed January 9 and 10, 1966, during NASA Flight Mission No. 18. Photographs were compared with each other and with black-and-white aerial photographs (approximate scale 1:55,000) to determine the relative value of each in interpreting the geology. The advantages and disadvantages of Ektachrome and Ektachrome infrared are discussed. Author

N70-41124*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A PHOTO-MOSAIC OF WESTERN PERU FROM GEMINI PHOTOGRAPHY
Jules A. MacKellor (Geol. Surv., Washington, D.C.) Oct. 1967 18 p refs Prepared by Geol. Surv., *Its* Interagency Tech. Letter NASA-87
(NASA Order R-09-020-013)
(NASA-TM-X-60596) Avail: NTIS CSCL 08B

A mosaic was prepared from photographs taken during the Gemini 9 mission. The 1:1,000,000-scale photo-mosaic extends from the Sechura Desert in northern Peru to northern Chile and from the Pacific Ocean to the headwaters of the Amazon. In addition to a wide variety of geological features, such things as landslides, roads, snow fields, irrigated lands, jungle agricultural sites, archeological sites, and smoke (brush burning) have been identified on the photo-mosaic. A lineation, interpreted as a major fault, extends across several photographs and for several hundred miles. This mosaic will supplement existing conventional maps and aerial photographs. Mosaics of photographs taken from space should be of considerable interest to the scientific community and of immense practical use in the efficient management of natural resources. Author

N70-41126*# Geological Survey, Salt Lake City, Utah.
GEOLOGICAL EVALUATION OF RADAR IMAGERY, SOUTHWESTERN AND CENTRAL UTAH
Lowell S. Hilpert Aug. 1966 16 p *Its* Tech. Lett. No. 38
(NASA Order R-09-020-015)
(NASA-CR-77595) Avail: NTIS CSCL 08G

Radar imagery was obtained with a high frequency side-looking radar along three flight lines having an aggregate length of about 650 mi. A selective evaluation indicates the radar imagery might be useful to broadly classify some rock units on the basis of their surficial textures or other characteristics. Tonal contrasts probably represent differences in the degree of soil development, moisture content of the soils, and the vegetative cover. Geologic structures are readily visible in the imagery where they are expressed physiographically and show with about the same clarity as in conventional photography. Subsurface structures without physiographic expression were not observed in the imagery. Railroads clearly show in the radar imagery, but only some roads can be seen. Blacktop roads show as dark lines if they are more than about 30 ft wide. Graded and unimproved dirt roads and blacktop roads less than 30 ft wide can also be detected as light lines where they are flanked by road cuts or earth fills. Author

N70-41144# Aeronautical Chart and Information Center, St. Louis, Mo. Geophysical and Space Sciences Branch.
MATHEMATICAL CARTOGRAPH, VOLUME 1
A. V. Graur 1970 348 p refs Transl. into ENGLISH from the book "Matematicheskaya Kartografiya" Leningrad; Leningrad Univ., 1956 p 1-348
(AD-709179; ACIC-LD-56-Vol-1) Avail: NTIS CSCL 8/2

The textbook discusses the theory of cartographic projections. Methods of computation and construction of the most important cartographic nets is investigated, and the mathematical basis of cartometry is described. Selected cartographic tables, computed according to F. N. Krasovskiys earth ellipsoid, are included in the Appendix, some of them published for the first time. The textbook contents are adjusted to the mathematical cartography curriculum for students of cartography in geography departments of universities. The book can be used by students from other educational institutions, and by operators in cartographic-geodetic practices.
Author (TAB)

N70-41145# Aeronautical Chart and Information Center, St. Louis, Mo. Geophysical and Space Sciences Branch.
MATHEMATICAL CARTOGRAPHY, VOLUME 2
A. V. Graur 1970 331 p refs Transl. into ENGLISH from the book "Matematicheskaya Kartografiya" Leningrad; Leningrad Univ., 1956 p 348-761
(AD-709180; ACIC-LD-56-Vol-2) Avail: NTIS CSCL 8/2

The document consists of volume 2 of the textbook Mathematical Cartography.
TAB

N70-41147*# Geological Survey, Washington, D.C.
GEOLOGIC EVALUATION OF RADAR IMAGERY IN SOUTHERN UTAH
R. J. Hackman Nov. 1966 24 p refs *Its* Tech. Letter NASA-58
(NASA Order R-09-020-015)
(NASA-CR-80782) Avail: NTIS CSCL 08G

Radar imagery extending from the Dark Canyon Plateau to Table Cliff Plateau in San Juan and Garfield Counties, Utah was enlarged and compared with conventional aerial photography to determine what geologic features, if any, could be recognized that were not present or were poorly defined on conventional photography. One fault was clearly visible on radar imagery that could only be poorly discerned on conventional photography. Calcareous and gypsiferous sedimentary rocks were shown as very light tones of gray in contrast to darker toned sandstones and shales. Fissile marine shales (dark tones) could be distinguished from sandstone members (light medium tones) and some calcareous beds (light tones). These contrasts were less conspicuous on the conventional aerial photography of the area. On the other hand, many of the rock units, readily distinguishable on the photography, could not be positively differentiated on the radar imagery.
Author

N70-41148*# Geological Survey, Washington, D.C.
SUMMARY OF SIGNIFICANT RESULTS OF REMOTE SENSING STUDIES IN 1965
W. D. Carter May 1966 21 p refs *Its* Tech. Letter NASA-14
(NASA Order R-09-020-013)
(NASA-CR-75462) Avail: NTIS CSCL 08G

The feasibility and applications of remote sensing devices mounted in earth orbiting spacecraft are being investigated as tools to study the geology, hydrology, geography, cartography, oceanography, agriculture, and forestry of the earth. Some of the significant results of these studies are summarized, which include analysis of black and white, color, near infrared, and multiband photography; and radar and infrared imagery from sites with varied geologic features. Results of studies on hydrologic, cartographic, and geographic applications of remote sensing data are also included.
R.N.A.

N70-41149*# Geological Survey, Washington, D.C.
LAKE SURVEYING TECHNIQUES IN THE GEOLOGICAL SURVEY Progress Report
H. E. Skibitzke and C. J. Robinove Jun. 1966 22 p *Its* Tech. Letter NASA-21
(NASA Order R-09-020-009)
(NASA-CR-76006) Avail: NTIS CSCL 08F

An outline is presented on lake studies, conducted to determine ways in which data could be collected synoptically and in a repetitive manner and analyzed for water resource classification and management. Airborne color and infrared photography were used to assess diurnal variation in radiation over both land and water surfaces, map the mixing of pollutants at the water-surface boundary, identify water surface color and bottom features, map the stage of eutrophication of lakes and the color as an indication of biological and chemical character, aid in the description of potholes as sources or sinks or ground water and their usefulness as wildlife breeding grounds, delineate mixing patterns in water, and measure light penetration and turbidity.
L.E.W.

N70-41150*# Geological Survey, Washington, D.C.
A PRELIMINARY EVALUATION OF AIRBORNE AND SPACEBORNE REMOTE SENSING DATA FOR HYDROLOGIC USES
Charles J. Robinove Jul. 1966 19 p refs *Its* Tech. Letter NASA-50
(NASA Order R-09-020-009)
(NASA-CR-76594) Avail: NTIS CSCL 08H

Remote sensors are examined as valuable tools for obtaining water-resource data on occurrence, movement, and interactions of water, and as a basis for control. Tabulated data present a brief evaluation of airborne and spaceborne remote sensors used in hydrology. Limited use of sensors is defined in the areas of measuring physical, chemical, and biological characteristics of water surfaces, mapping and describing ground-water features, snow surveying and mapping, glaciology, geomorphology, and measuring liquid-vapor transfer.
S.P.

N70-41161*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
HIGH ALTITUDE RADIATION MEASUREMENTS Quarterly Report, 1 Jan.-31 Mar. 1970
Fred L. Bartman Apr. 1970 20 p refs
(Contract NSR-23-005-376; ORA Proj. 03835)
(NASA-CR-113896; Rept-03635-2-P) Avail: NTIS CSCL 04A

Experimental work discussed includes the high resolution measurements of the 15 micrometer band of CO2 and the development of an ozone generating handling and measuring system. Theoretical analysis of the high resolution 15 micrometer CO2 data and of the 9.0 micrometer O3 band were initiated.
Author

N70-41162*# Michigan Univ., Ann Arbor. School of Natural Resources.
REMOTE SENSING APPLICATIONS IN FORESTRY: REMOTE SENSING OF CHANGES IN MORPHOLOGY AND PHYSIOLOGY OF TREES UNDER STRESS Annual Progress Report
Charles E. Olson, Jr., Jennifer M. Ward, and Wayne G. Rohde Berkeley, Calif. Calif. Univ. 30 Sep. 1969 47 p refs Prepared in cooperation with Calif. Univ., Berkeley and Dept. of Agr. Forest Serv.
(NASA Order W-12996)
(NASA-CR-113803; APR-3) Avail: NTIS CSCL 02F

Statistical evaluations of reflectance data for sugar maple (Acer saccharum) indicated that remote detection of plant damage due to salt accumulation is most likely at wavelengths between 1.43 and 2.19 micrometers. Significant increases in reflectance were observed in the photographic infrared spectral region (0.8 to 1.2 micrometers) for low levels of salt, but not for high levels of salt. Reflectance measurements made for foliage on watered and unwatered yellow poplar (Liriodendron tulipifera) seedlings agree with data previously reported. Leaves which reached full size before watering ceased showed a slight increase in reflectance at most

wavelengths when the plants were subjected to severe moisture stress. Leaves which unfolded under severe moisture stress were less reflective at all wavelengths. White ash (Fraxinus americana) leaves unfolding under severe moisture stress were more reflective than leaves on watered plants, however. Results with sugar maple were similar to those for ash. Radiometric temperatures were consistently higher for stressed than unstressed plants. Author

N70-41164*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

REMOTE SENSING APPLICATIONS IN FORESTRY: THE USE OF MULTISPECTRAL SENSING TECHNIQUES TO DETECT PONDEROSA PINE TREES UNDER STRESS FROM INSECT OR DISEASES Annual Progress Report

R. C. Heller, R. C. Aldrich, W. F. McCambridge, and F. P. Weber Calif. Univ. 30 Sep. 1969 67 p refs

(NASA Order W-12996)

(NASA-CR-113804; PR-4) Avail: NTIS CSCL 02F

Objectives of the research were: (1) to determine the best film and scale combination for detecting small infestations 1-3 trees in size; and (2) to determine the limits for detecting bark beetle infestations on space photography. The 15-channel optical-mechanical scanner data collected by aircraft in May 1968 were processed and interpreted by several techniques. Ten channels of spectrometer data were processed in an analog multispectral processor. Four color coded film strips were produced by the processor to represent each of four tree condition classes. These films showed a good relationship in the faded uninfested condition class between actual number of trees on the ground and number of recognized targets. Individual waveband analysis showed discriminating wavebands for old-kill and faded infested trees. However, it required all 10 channels to detect nonfaded (previsual) infested trees. Of three single-channel infrared processing techniques, the gated analog method with reference-plate clipping resulted in the best information for locating previsual beetle-attacked trees. Author

N70-41177*# Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.

A SEQUENTIAL LINEAR DISCRIMINANT ANALYSIS PROGRAM FOR GEOLOGICAL AND REMOTELY-SENSED DATA

E. H. Timothy Whitten 15 Jul. 1970 26 p refs

(Grant NGR-14-007-027)

(NASA-CR-113501; Rept-22) Avail: NTIS CSCL 08G

A FORTRAN 4 Program for CDC 6400 is presented together with sample output illustrating the use of sequential linear discriminant analysis. Author

N70-41179*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.

CALIBRATIONS OF THE ARECIBO FACILITY FOR IONOSPHERIC STUDIES

D. E. Baran 30 Jul. 1970 76 p refs

(Grant NGL-39-009-003)

(NASA-CR-113857; SR-360) Avail: NTIS

Results of calibrating the Arecibo facility for ionospheric studies are reported. Investigations of measured parameters were generally confined to the area of the F2 peak. Of primary interest were the day to night backscatter gain fluctuations. Ten standard ionospheric experiments along with several variations of these were employed in order to obtain statistical data with regard to the parameters of the ionosphere radar equation. Temperature measurements on the antenna structure and radio astronomy measurements were made to determine the cause of the gain fluctuations. In addition, theoretical studies of gain variations resulting from temperature changes were made. Results showed that the backscatter gain variations are caused by distortion of the reflector surface which in turn is caused by temperature fluctuations. The accuracies of the radar equation parameters were determined and are given. Author

N70-41202# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Geo-Astrophysics Section.

OPTICAL REMOTE SENSING OF BIORESOURCES

W. G. Egan Aug. 1970 24 p refs Presented at the Natl. Symp. on Hydrobiol., Miami Beach, Fla., 24 – 27 Jun. 1970; sponsored by the Am. Water Resources Assoc.

(RM-482J) Avail: NTIS

Two classes of sensors are used, photographic and electronic. Photography is limited to uses where color contrasts are evident. Accurate objective color specification is limited by such control problems as: manufacture and storage, exposure development, and evaluation. Photometric accuracies of approximately 2 percent or better are indicated when precision calibration and control techniques are used by astronomers for photographic spectrophotometry. Infrared film is widely used for photographic remote sensing of earth resources, in applications ranging from hydrology and bioresources to forestry and agriculture. Interpretation of colors may be made by using Munsell color standards or objectively by spectrophotometry. Colors are meaningless, however, unless a careful calibration program supplements the photography. An approach to remote sensing that uses all the optical information contained in scattered light appears to offer increased accurate characterization of earth resources. This information is embodied in Stokes parameters. The first Stokes parameter describes the brightness; the second, the relative polarization; the third, the plane of polarization; and the fourth, the circular polarization. Techniques have been evolved to sense remotely the Stokes parameters of water and land environments are described. This approach appears to permit identification of bioresources below the resolution limit for a given set of hardware. Author

N70-41217*# California Univ., Berkeley. Forestry Remote Sensing Lab.

REMOTE SENSING APPLICATIONS IN FORESTRY. THE DEVELOPMENT OF SPECTRO-SIGNATURE INDICATORS OF ROOT DISEASE IMPACTS ON FOREST STANDS Annual Progress Report

John F. Wear (Pacific Southwest Forest and Range Expt. Center) and F. P. Weber (Pacific Southwest Forest and Range Expt. Center) 30 Sep. 1969 62 p refs Prepared in cooperation with Dept. of Agr.

(NASA Order W-12-996)

(NASA-CR-113895) Avail: NTIS CSCL 02F

Remote sensing research was conducted to identify parameters that best discriminate healthy Douglas-fir trees from those infected with Poria weirii root-rot. Biophysiological investigations were emphasized to gather data on emitted radiation from the two types of tree crowns (healthy and diseased). Remote sensing in the thermal infrared region shows great promise for the early detection of root-rot infected trees. An aerial tramway system was designed and installed for use as a remote sensing platform from which to record continuous data. Two trams were needed because of the difficulties involved in aligning trees in the natural second-growth stand over which environmental data would be taken. The design and installation procedures for establishing the tramway system and the wide array of instrumentation needed in this phase of the study are described and illustrated. A major objective of this remote sensing research is to investigate the possibilities of detecting stress trees on satellite imagery. Such a study was conducted with Apollo 9 photography and is described in this report. Author

N70-41272# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.

CONTAINMENT OF OIL SPILLS BY PHYSICAL AND AIR BARRIERS

David P. Hoult [1970] 23 p refs Sponsored in part by Federal Water Pollution Control Agency
(Contract DOT-CG-00491-A) Avail: NTIS

A review of barriers to contain oil is presented. The main design parameters for a physical barrier in a steady current are presented. Included are discussions of draw down, forces, moments, and the configuration a boom takes on when deployed in a current. In each topic, comparison is made with experimental results and available theory. It is shown that a properly designed boom may hold large amounts of oil against a steady current. A brief discussion of the implications of these new results for air barriers is presented.
Author

N70-41282*# California Univ. Berkeley. Forestry Remote Sensing Lab.
REMOTE SENSING APPLICATIONS IN FORESTRY: ANALYSIS OF REMOTE SENSING DATA FOR EVALUATING FOREST AND RANGE RESOURCES Annual Progress Report
Robert N. Colwell et al 30 Sep. 1969 211 p refs Prepared in cooperation with Dept. of Agr.
(NASA Order W-12996)
(NASA-CR-113912) Avail: NTIS CSCL 02F

The rationale is given for a systematic forestry remote sensing research program. The unit organization of the laboratory that has been developed in order to conduct a comprehensive program is described, and a statement is given of the types of programs that are investigated by the laboratory's five major units, which are: (1) operational feasibility, (2) spectral characteristics, (3) image enhancement and interpretation, (4) automatic image classification and data processing, and (5) training. A maximum effort has been made to relate remote sensing capabilities to user requirements, based on the presumption that the primary user will be the actual manager of earth resources.
Author

N70-41303# Bureau of Mines, Minneapolis, Minn. Mining Research Center.
ROCK FRAGMENTATION BY CREATING A THERMAL INCLUSION WITH DIELECTRIC HEATING
Kuppusamy Thirumalai Sep. 1970 37 p refs
(BM-RI-7424) Avail: Issuing Activity

The fragmentation of rock using the proposed method is analyzed and qualitatively compared with the results of experiments with charcoal granite, Dresser basalt, and Sioux quartzite. High frequency dielectric heating below 100 MHz is used as an example to examine the working of the concept. The selection of operating conditions for the experimental heating is explained. Fragmentation of charcoal granite and Dresser basalt test rock blocks is achieved for localized heating below 550 C. The heated volume required for fragmentation is observed to be less than 2 percent of the test block volume and the electrical energy consumption is in the order of 3.5 to 6.5 kwhr/cum. The method offers a possibility for in situ fragmentation of rocks, favorable for internal heating. The method is highly dependent on rock properties governing internal heat generation. The efficiency of dielectric heating in the experimental study is observed to increase with increasing dielectric loss of the rock material, ranging from about 10 percent in Sioux quartzite to about 50 percent in Dresser basalt.
Author

N70-41326# Aerospace Corp., El Segundo, Calif. Lab. Operations.
MUTUALLY INTERACTING INSTABILITIES IN THE MAGNETOSPHERE, JULY 1968–JULY 1969
John M. Cornwall 29 Jun. 1970 24 p refs
(Contract F04701-69-C-0066)
(AD-709200; TR-0066(5260-20)-18; SAMSO-TR-70-233) Avail: NTIS CSCL 4/1

The mutual interaction of a drift wave instability and a high-frequency instability is studied. When both instabilities are present in a plasma, the usual dispersion relation for the drift wave is modified by terms involving the wave intensity of the high-frequency instability; generally, damping results. An example is worked out: the Mikhailovskii-Rudakov drift Alfven mode, in the presence of an electron cyclotron instability. For auroral magnetospheric parameters, high-frequency damping is comparable to the usual linear growth rate for the drift instability.
Author (TAB)

N70-41328# Bureau of Mines, Denver, Colo. Mining Research Center.
ROCK NOISE SOURCE LOCATION TECHNIQUES
Fred Leighton and Wilson Blake Sep. 1970 21 p refs
(BM-RI-7432) Avail: Issuing Activity

Rock noise source location techniques that may be used to obtain precise and practical source locations from microseismic field data are reviewed. These techniques enable one to monitor all or any part of a rock structure and map progressive stress buildup or rock movement. Thus, the microseismic method of determining instability in rock structures is becoming an invaluable engineering tool for the mining or civil engineer engaged in rock excavation and construction.
Author

N70-41391# Texas Univ., Austin. Atmospheric Science Group.
A STUDY OF PRECIPITATION, STREAMFLOW, AND WATER USAGE ON THE UPPER RIO GRANDE
Elden V. Jettson (Weather Bur., El Paso, Tex.) and James W. Kirby (Bur. of Reclamation, El Paso, Tex.) Jun. 1970 213 p refs
(Rept-25) Avail: NTIS

The upper Rio Grande watershed is one of the oldest inhabited, oldest irrigated, and fastest growing sections of the United States. There are some indications that the water resources of the basin have been overcommitted under the present form of usage. Drought during the late 1940's and the 1950's caused disastrous reductions in streamflow. The shortage was not uniform, with the lower reaches of the basin suffering the most. Analysis of precipitation and stream-flow records indicate the water delivered to New Mexico and Texas declined much more than did the annual rainfall over the Rio Grande Basin in Colorado or the flow of streams in that area above significant diversions and use.
Author

N70-41432# Congress. Senate. Committee on Public Works.
RESOURCE RECOVERY ACT OF 1969, PART 3 From the Subcommittee on Air and Water Pollution
Washington GPO 1970 345 p refs Hearings on S. 2005 before Comm. on Public Works, 91st Congr., 2d Sess., 20 and 23-25 Feb. 1970
Avail: SOD $1.75

The statements of various witnesses before the subcommittee provide information on the relationship of the environmental pollution problem to the health of the people. Projected financial assistance is concerned with the recovery, reuse, and recycling mechanisms of solid waste facilities.
G.G.

N70-41433# Congress. Senate. Committee on Public Works.
RESOURCE RECOVERY ACT OF 1969, PART 4 From the Subcommittee on Air and Water Pollution
Washington GPO 1970 198 p refs Hearings on S. 2005 before Comm. on Public Works, 91st Congr., 2d Sess., 26-27 Feb. and 3 Mar. 1970
Avail: SOD $1.25

Federal funding for the construction of solid waste disposal facilities is requested to help eliminate environmental pollution caused by the paper, mining, and secondary material industries. Emphasis is placed on the various aspects of reclamation processes and their practicalities.
G.G.

N70-41434# Congress. Senate. Committee on Public Works.
RESOURCE RECOVERY ACT OF 1969, PART 5 From the Subcommittee on Air and Water Pollution
Washington GPO 1970 350 p refs Hearings on S. 2005 before Comm. on Public Works, 91st Congr., 2d Sess., 4-5 and

13 Mar. 1970; also in San Francisco, 31 Mar. 1970
Avail: SOD $1.75

The regional aspects of waste disposal requirements are considered and the development of recommended standards consistent with health, air, water, and land use plans is recommended. Special care has to be taken with the disposal of hazardous wastes of chemical, biological, and radioactive background. Improved solid waste handling and disposal systems require additional federal funding because many county systems will not be able to absorb increasing costs. G.G.

N70-41435# Congress. Senate. Committee on Commerce.
FEDERAL OCEANIC AND ATMOSPHERIC ORGANIZATION, PART 1
Washington GPO 1970 775 p refs Hearings on S. 2841 and S. 2802 before Comm. on Com., 91st Congr., 1st and 2d Sess., 17 Dec. 1969 and 9-10, 17-18, 24, and 26 Feb. 1970
Avail: Subcomm. on Oceanog.

Amendments to the marine resources and development act cover the establishment of a comprehensive and long-range national program for developing and utilizing the oceans and the atmospheric environment. The formation of a National Oceanic and Atmospheric Agency (NOAA) is advocated which would plan and execute projects to develop fundamental understanding of the biological, physical, and chemical characteristics of the marine environment and the atmosphere and assists the states in establishing coastal management programs. G.G.

N70-41444# Environmental Research Corp., Alexandria, Va.
SEISMIC RESPONSE CHARACTERISTICS AT TONOPAH, NEVADA FROM UNDERGROUND NUCLEAR DETONATIONS
Spencer L. Williams, Lawrence L. Davis, C. T. Spiker, and Lewis R. West May 1970 121 p refs
(Contract AT(29-2)-1163)
(NVO-1163-204) Avail: NTIS

The seismic response of Tonopah, Nevada, is defined by analyzing seismic data observed from underground nuclear detonations at the Nevada Test Site (NTS) and one (Faultless) detonated at the Central Nevada Test Area (CNTA). The response at Tonopah varies with the location of the detonation. Pahute Mesa and CNTA detonations produce seismic signals richer in high frequency energy than would be expected on the basis of NTS average experience. This results in peak acceleration amplitudes being considerably higher than normal. Yucca Flat detonations produce more nearly normal response at Tonopah. Ground motions observed at a number of Tonopah sites instrumented for the Clarksmobile detonation (Yucca Flat) confirm that the seismic response at two sites, Tonopah Motel (alluvium), and Tonopah Church (hardrock), which have been instrumented for many detonations, are representative of average response in the Tonopah area. Author (NSA)

N70-41459# National Science Foundation, Washington, D.C.
COLLECTED PAPERS OF SOVIET ANTARCTIC EXPEDITIONS [NAUCHNYE REZULTATY RABOT SOVETSKIKH ANTARKTICHESKIKH EKSPEDITSII]
V. G. Averyanov 1969 278 p refs Transl. into ENGLISH from Tr. Sovetskaya Antarkt. Ekspeditsiya, v. 38, 1968
(TT-69-55085) Avail: NTIS CSCL 08G

Contents: Physiographic characteristics of Molodezhnyi oasis; Eolian microrelief forms of snow surface on glaciers in Antarctica and the Arctic; Changes in the surface and the radiation-active layer of snow and ice in the thaw period; Inverted glaciological zonality in the eastern part of Princess Astrid coast; Formation conditions and certain properties of Antarctic sea ice. Bottom relief and sedimentation in east Antarctic seas; Geomorphology, sediments and suspended material of the shelf and continental slope of Antarctica; Atmospheric circulation in the southern hemisphere and synoptic processes in the Antarctic; Climatic conditions in the Schirmacher oasis; The meteorological and radiational Mirny in 1965; Nonperiodic variations of direct solar radiation in the Antarctic; Condensation nuclei in the Mirny region; Gales in the Pravda coast region; Some features of the thermal structure of the surface wind field at Mirny; Transmission of short radio waves in the Antarctic during minimum solar activity. USGRDR

N70-41481*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PRELAUNCH, LAUNCH AND INFLIGHT ENVIRONMENT
In its Nat. Environment Criteria for the NASA Space Sta. Program (2d ed.) 20 Aug. 1970 p 3–28 refs (See N70-41480 23-30)
Avail: NTIS CSCL 04A

Natural environmental criteria are provided for studies related to the design and operation of the NASA space stations and launch vehicles during prelaunch, launch, and in flight phases. Gas properties, prelaunch, launch, and inflight winds, and rigid and elastic vehicle studies are discussed. Tables of annual thermodynamic quantities associated with extreme density for Cape Kennedy, coefficients of variation and discrete altitude level correlation coefficients between pressure-density, pressure-temperature and density-temperature for the Eastern Range, and Cape Kennedy reference atmosphere versus geometric altitude are included. K.M.

N70-41482*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EARTH ORBITAL ENVIRONMENT
In its Nat. Environment Criteria for the NASA Space Sta. Program (2d ed.) 20 Aug. 1970 p 29–76 refs (See N70-41480 23-30)
Avail: NTIS CSCL 04A

Natural environmental criteria are presented for the design and operation of NASA space stations and launch vehicles during the earth orbital phase. Gas properties for the lower and upper thermosphere and ionosphere are discussed as well as an atmospheric model for orbital altitudes. Galactic cosmic and trapped radiation, solar particle events, and supplemental information are outlined along with earth thermal and albedo radiation, and solar thermal radiation. Meteoroid and geomagnetic environments, solar cycle predictions, and astrodynamic constants are included with appropriate equations. J.M.

N70-41659# Nevada Univ., Reno. Mackay School of Mines.
SPECIAL AERIAL PHOTOGRAPHY NEAR THE NEVADA TEST SITE Final Report
David B. Slemmons, George E. Brogan, Gary A. Carver, Charles E. Glass, and Robert L. McDonald Jun. 1970 21 p
(Contract AT(26-1)-454; Grant AF-AFOSR-1564(68))
(AD-709735; AFOSR-70-2035-TR) Avail: NTIS CSCL 18/3

The project had two prime purposes: (1) The first objective was to provide geologic and photogrammetric support to the United States Coast and Geodetic Survey, Lamont Geological Observatory, University of Nevada Seismological Laboratory and the Atomic Energy Commission for the Benham underground nuclear test. This support was in the form of large-scale aerial photography and aerial reconnaissance of their survey nets across active faults and any microearthquake arrays with post-test local activity. These photographs were then made available to these organizations or institutions upon request, for precise location and mapping of their nets and arrays. (2) The second objective was to provide large-scale, low sun angle illumination photography of the highly active Winnemucca-Ventura Seismic Zone with special emphasis placed on the Owens Valley, Panamint Valley, Fish Lake Valley, Furnace Creek and Death Valley fault zones along with many other active fault zones located near, but not on the test site. This second objective was to provide before and, if necessary, after aerial photography and ground geological reconnaissance to determine whether any movement along these major active zones was the result of the Benham and other following nuclear tests. Author (TAB)

N70-41662# California Univ., Berkeley. Lawrence Radiation Lab.
T-WAVE: A COMPUTER CODE FOR ANALYZING THE NONSTEADY GRAVITY DECAY OF A GOUNDWATER ANOMALY
John A. Korver 16 Mar. 1970 59 p refs
(UCRL-50830) Avail: NTIS

The T-WAVE Code is based on a one-dimensional numerical model describing the gravity decay of a groundwater mound. The Fortran program for the T-WAVE Code may be used to examine the time-dependent flow characteristics of anomalous groundwater mounds resulting from underground nuclear explosions near or below the regional water table. The code allows the permeability and/or porosity to be in either a cylindrical or spherical geometry surrounding the shot point, and it also allows for internal horizontal or vertical discontinuities of the permeability or porosity. It is also possible to follow the horizontal displacement of ideally tagged water particles as a function of time. Author (NSA)

N70-41666# Naval Civil Engineering Lab., Port Hueneme, Calif.
SALVAGE WORK PROJECTS: SEALAB 3 Technical Report, Jan. 1967–Jun. 1969
John J. Bayles Jun. 1970 143 p refs
(AD-709423; NCEL-TR-684) Avail: NTIS CSCL 13/10

The SEALAB III program, under the direction of the Ocean Engineering Branch, Deep Submergence Systems Project Office, was initiated to advance the state-of-the-art of mans capability to live and work in the deep ocean environment. It is the goal of the Salvage Projects for SEALAB III to demonstrate and field test some of the more important new salvage devices and techniques. This report discusses the aquanaut familiarization and training phases associated with the Salvage Projects planned for Team Two--SEALAB III, and the modifications to both equipments and procedures as suggested by the divers. Preliminary results are included with recommendations regarding future plans. Author (TAB)

N70-41667# Westinghouse Research Labs., Pittsburgh, Pa.
EXPERIMENTAL MEASUREMENTS ON ATOMIC COLLISION PROCESSES RELATED TO ATMOSPHERIC PHYSICS Final Report, 15 Mar.–15 May 1970
Arthur V. Phelps and John L. Pack 10 Jun. 1970 60 p refs
(Contract F19628-70-C-0225)
(AD-709420; AFCRL-70-0342) Avail: NTIS CSCL 4/1

A combination drift tube and quadrupole mass spectrometer was used to make measurements of the rate coefficients for the hydration of thermal energy atmospheric negative ions at low partial pressures of water vapor in oxygen at 300K. The partial pressure of the water was determined from measurements of the rate of production of positive ions produced by electron ionization of the gas effusing from the orifice between the drift tube and the mass spectrometer. Author (TAB)

N70-41668# California Univ., Berkeley. Lawrence Radiation Lab.
HYDROLOGIC DATA REDUCTION TECHNIQUES AND UNIT CONVERSIONS FOR USE IN THE OGRE, T-WAVE, FLIP, AND RAVE FLUID FLOW CODES
John A. Korver 13 Mar. 1970 8 p refs
(UCRL-50854) Avail: NTIS

Methods used to determine kH, the permeability-thickness product for a given location, from hydrologic test data are described, and methods for converting the units of permeability to the correct dimensional form for use in specific computer codes for analyzing ground water flow are presented. NSA

N70-41705# Norwegian Defence Research Establishment, Kjeller.
NORSAR (NORWEGIAN SEISMIC ARRAY), PHASE 1: OPERATION AND MAINTENANCE Technical Report, 1 Feb.–30 Nov. 1968
Oct. 1969 105 p
(Contract F61052-68-C-0009; ARPA Order 800)
(AD-709512; NDRE-S-41; ESD-TR-70-210) Avail: NTIS CSCL 8/11

The report covers the operation and maintenance of the NORSAR PHASE 1 seismic system during the period 1 February through 30 November 1968. The report has four chapters: A short introduction states the purpose of the operation of the Phase 1 system and defines the O + M tasks. A rather detailed description of the system is given, covering geographical configurations, constructional and other technical layouts. The third chapter describes the O + M organization and its facilities, and lists the working routines and records. Finally the operational experiences are summed up, partly as a narrative of the operations, partly in the form of graphical statistics. Author (TAB)

N70-41716# Israel Program for Scientific Translations, Ltd., Jerusalem.
ANTARCTICA. COMMISSION REPORTS 1962
V. A. Bugaev, ed. 1969 193 p refs Transl. into ENGLISH of the publ. 'Antarktika. Dokladykomissii 1962' Moscow, Izd. AN SSSR, 1963 p 1–185 Sponsored by NSF
(TT68-50491) Copyright. Avail: NTIS

Contents: Geological structure of the central Queen Maud Land mountains in east Antarctica: Morphometric parameters; Blank areas on maps; The geomorphological map; Physiographic zoning map; Paleogeography; Lakes in the mountains; The trend of recent changes in ice sheet; Bottom melting of ice shelves; Contribution to studies of chemical runoff; Snowdrift measurements, snow and ice evaporation; Results of actinometric sounding of the atmosphere; Atmospheric circulation and sastrugi in east Antarctica; Ground inversions and airplane flights; Effect of weather and hydrological conditions on the migration and distribution of whales; Navigation charts compiled by the Bellingshausen-Lazarev expedition in 1819-1821; U.S. expeditions (1838-1962); A new basis for the solution of controversial aspects of Antarctic history. USGRDR

N70-41743*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EQUATION FOR VORTEX MOTION INCLUDING EFFECTS OF BUOYANCY AND SOURCES WITH APPLICATIONS TO TORNADOES
Robert C. Costen Washington Oct. 1970 65 p refs
(NASA-TN-D-5964; L-5738) Avail: NTIS CSCL 04B

A new equation is derived for the motion of vorticity in a general fluid, including the effects of viscosity, compressibility, nonhomogeneity, and nonconservative forces. The equation holds, in particular, for vortices which may not move with the fluid. A linearized form of this equation is applied to tornado cyclones and to the twin tornado of April 11, 1965, near Elkhart, Indiana. It is shown that the displacement of tornado cyclones to the right of the mean tropospheric winds may be accounted for by the upward efflux of fluid from the cyclone into the jet stream. Also, the retarded revolution rate of the twin tornado may be due in part to an attractive buoyancy force acting on the partially rarefied cores of the pair. Author

N70-41748# Congress. Senate. Committee on Commerce.
FEDERAL OCEANIC AND ATMOSPHERIC ORGANIZATION, PART 2
Washington GPO 1970 398 p refs Hearings on S. 2802, S. 2393, S. 3118, S. 3183, and S. 3460 before Comm. on Com., 91st Congr., 1st and 2d Sess., 23 Mar., 2, 9, 14, 16, 21 Apr., and 4 May 1970 /ts Serial No. 91-59
Avail: Subcomm. on Oceanog.

The Senate hearings on the bills concerning the management, protection, planning and development of coastal zone programs are reported. Topics discussed include: (1) scientific and engineering facilities needed, (2) training of coastal zone scientists and engineers, (3) financial support, (4) pollution damages, (5) dredging and filling, and (6) joint state-local-federal participation. F.O.S.

N70-41751# Lamont Geological Observatory, Palisades, N.Y.
RESEARCH DIRECTED TOWARD THE USE OF LONG AND INTERMEDIATE PERIOD SEISMIC WAVES FOR THE IDENTIFICATION OF SEISMIC SOURCES Annual Technical Report, 1 Aug. 1969 – 1 Jul. 1970
John A. Kelleher Jul. 1970 25 p refs
(Contract F19628-68-C-0341; ARPA Order 292)
(AD-709410; ATR-2; AFCRL-70-0391) Avail: NTIS CSCL 17/10

Seismological research at the Lamont-Doherty Geological Observatory is summarized for the period 1 August 1969 to 1 July 1970. During this period extensive analysis was done on the excitation of long-period (15-70 second) Rayleigh and Love waves by earthquakes, underground explosions and presumed explosions. Author (TAB)

N70-41752# Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
BEACH CHANGES BY EXTRAORDINARY WAVES CAUSED BY HURRICANE CAMILLE
Choule J. Sonu Feb. 1970 21 p refs Repr. from Coastal Studies Bulletin 4
(Contract Nonr-1575(03); Nonr-1575(00))
(AD-709428; TR-77) Avail: NTIS CSCL 8/3

Drastic erosion and swift recovery were the major characteristics of beach changes associated with Hurricane Camille at Fort Walton, Florida. Storm waves caused general erosion of the beach surface, and a scarp about 1 meter deep was produced about 40 meters behind the shoreline. After the hurricane, humps of sand in a train with regular spacing along the shore emerged in the surf zone bed. These were formed by longshore currents, which probably acted on large quantities of sand brought into the surf zone bed as a result of the preceding subaerial erosion. The humps subsequently moved shoreward and eventually climbed on the beach; a substantial part of the exposed beach volume was thus restored about a week after the hurricane. Author (TAB)

N70-41777# Environmental Research Corp., Alexandria, Va.
ANALYSIS OF SEISMIC DATA, MILROW EVENT
D. L. Orphal, C. T. Spiker, L. R. West, and M. D. Wronski May 1970 83 p refs
(Contract AT(29-2)-1163)
(NVO-1163-209) Avail: NTIS

Peak resultant vector surface particle ground motions and pseudo-relative velocity (PSRV) spectra derived from seismograms from Milrow agree well with predictions for a 1,000 kt event. Predictions were made on the basis of statistical analyses of ground motions recorded from numerous underground nuclear events at the Nevada Test Site (NTS). The agreement between the observed and predicted amplitude and frequency characteristics of the Milrow ground motions suggests that the effect of source, transmission path, and recording site parameters for Milrow is similar to that at the NTS for comparable detonations. Comparison of selected radial seismograms and PSRV spectra from Milrow with corresponding data recorded at comparable distances from Boxcar and Benham, confirms this suggestion. The time-histories and spectral content of the Milrow ground motions are similar to those observed from Boxcar and Benham. The successful application of prediction methods based upon NTS experience to the Milrow event suggests that ground motions can be accurately predicted for underground nuclear detonations on Amchitka Island. NSA

N70-41788# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDY OF METEOR WIND MEASUREMENT TECHNIQUES, VOLUME 1 Final Report, 1 Jun. 1963 – 31 May 1966
Norman F. Deegan, Robert J. Fitzpatrick, Giuseppe Forti, Mario D. Grossi, and Mario R. Schaffner Feb. 1970 135 p refs
(Contract AF 19(628)-3248)
(AD-709232; AFCRL-70-0168-Vol-1) Avail: NTIS CSCL 4/1

Wind data in the height range 80 to 100 km can be obtained with a multistatic VHF phase-coherent pulse-doppler meteor radar capable of monitoring a volume in space measuring approximately 50 km x 50 km horizontally, and 20 km vertically. An eight-station phase-coherent system has been established for this purpose near Havana, Illinois, by reworking an existing six-station, incoherent, pulse meteor radar operating at 40.92 MHz. A 4-Mw transmitter and eight receiving sites dispersed up to 50 km away from the transmitter site have been locked together in phase within a few parts in 10 to the 10th power by distributing a 2.5 kHz reference tone via commercial telephone lines. The system operates satisfactorily and is capable of collecting enough range-doppler samples from meteor trails for an adequate description of the wind pattern at meteor heights. Wind profiles have been obtained by processing in Cambridge with a CDC-6400 computer the multichannel digital tapes recorded in Havana. The method can, potentially, be used for real-time wind measurements. It competes favorably with alternative approaches when wind measurements at meteor height must be performed with continuity and without resorting to horizon-to-horizon spatial averaging. Author (TAB)

N70-41789# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDY OF METEOR WIND MEASUREMENT TECHNIQUES, VOLUME 2 Final Report, 1 Jun. 1963 – 31 May 1966
Norman F. Deegan, Robert J. Fitzpatrick, Giuseppe Forti, Mario D. Grossi, and Mario R. Schaffner Feb. 1970 240 p
(Contract AF 19(628)-3248)
(AD-709233; AFCRL-70-0168-Vol-2) Avail: NTIS CSCL 4/1

For abstract see N70-41788.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N70-40406# RAND Corp., Santa Monica, Calif.
HOLOGRAPHY IN A SPATIALLY INHOMOGENEOUS MEDIUM
H. T. Yura Jun. 1970 21 p refs
(AD-708911; P-4394) Avail: NTIS CSCL 20/6

A Huygens-Fresnel principle, extended to a medium which exhibits a spatial variation in the index of refraction, is used to calculate the resulting fringe patterns in the Fresnel-Fraunhofer and point reference Fourier-Transform methods of holography. In particular, the resolution limits pertaining to these two methods are derived. Numerical results pertaining to underwater holography are given. Author (TAB)

N70-40514# Army Aviation Test Activity, Edwards AFB, Calif.
WIND TUNNEL AND FLIGHT EVALUATION ROSEMOUNT SHIELDED PITOT-STATIC TUBE MODEL 850N Final Study, Jul. 1967 – Feb. 1970
Kenneth R. Ferrell, John J. Shapely, Jr., and Jervis Mishlof Apr. 1970 43 p
(AD-708859; USAASTA-68-12) Avail: NTIS CSCL 14/2

Test airspeed probes are generally of a fixed or swiveling pitot-static type. Fixed probes are inaccurate at the low speeds and large inflow angles common to helicopter flight regimes. Swivel head probes provide more accurate information, but are often limited by the dynamic pressure they can withstand. A fixed probe which was reportedly not sensitive to angles of attack or sideslip was tested in the wind tunnel and on a helicopter to evaluate suitability for use as a test instrument. Author (TAB)

N70-40525+ British Broadcasting Corp., Kingswood (England). Research Dept.

BBC TEST CHART 67: A NEW GREY SCALE REFLECTANCE CHART FOR COLOUR TELEVISION CAMERAS

S. J. Lent Aug. 1970 8 p refs
(BBC-1970/30) Avail: NTIS

The design considerations and use of a new grey-scale reflectance chart for color cameras and the construction of a prototype chart based on the new design specification are described. Author

N70-40532 National Lending Library for Science and Technology, Boston Spa (England).

A NEW MAGNETIC OXYGEN METER WITH VERY SHORT RESPONSE TIME AND HIGH SELECTIVITY

N. H. Hummel 22 Jun. 1970 12 p refs Transl. into ENGLISH from Chem.-Ing.-Tech. (Weinheim), v. 40, no. 19, 1968 p 947–951
(NLL-CE-Trans-5304-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The device measures the susceptibility of a gaseous mixture directly and continuously. Through two inlet tubes the measuring gas and reference gas, respectively, are fed into the sealed core (transverse core) of an electromagnet energized by alternating current at 50 Hz. The resulting alternating pressure, which is proportional to the difference in susceptibility of the measuring gas and reference gas and is a measure of the difference in O2 content of the two gas streams, is measured with an electrostatic microphone. The new device is characterized by an extremely high indication speed (transit time < 0.1 s) and low dependence on the composition of the carrier gas, and therefore has a wide range of application both in engineering and medical investigations. Author

N70-40577# Utah Univ., Salt Lake City. Dept. of Chemistry.

HIGH RESOLUTION CHEMICAL IONIZATION MASS SPECTROSCOPY Final Report, Nov. 1967 – Dec. 1969

Jean H. Futrell May 1970 72 p refs
(Contract F33615-68-C-1135)
(AD-708731; AFML-TR-70-65) Avail: NTIS CSCL 7/4

A high resolution chemical ionization mass spectrometry system of high sensitivity has been developed. The resolving power of the instrument M/Delta M exceeds 50,000, and the sensitivity and quantitative accuracy are comparable to electron impact mass spectroscopy. At the same time, the spectra are much simpler and easier to interpret than conventional spectra. Salient features of chemical ionization mass spectroscopy are reviewed, and a detailed description of instrument modifications necessary for these experiments is given. Data for several miscellaneous experiments illustrating the performance are given and a systematic study of the aliphatic alcohols using methane, propane, and isobutane reagent gases is reported. Ion motion under the influence of a weak electric field with the assumption of many collisions is discussed, and it is demonstrated that satisfactory kinetic data may be obtained under these experimental conditions. The possibility that equilibrium may also exist at typical temperatures and pressures is discussed, and the metastable defocus technique is used to establish both mechanisms and properties of the reaction complex in these low-energy ion-molecule reactions. Author (TAB)

N70-40598 National Lending Library for Science and Technology, Boston Spa (England).

INERTIALESS MONITORING OF A NEUTRON FLUX LEVEL BY A PRIMARY EMISSION DETECTOR USING A SILVER EMITTER

I. Ya. Emelyanov et al. Apr. 1970 9 p refs Transl. into ENGLISH from At. Energiya (USSR), v. 27, no. 3, Sep. 1969 p 230–232
(NLL-DOUNREAY-Trans-450-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The results of testing a primary emission detector (PED) in the form of a coaxial cable having a central core of silver, magnesium oxide insulation, and a sheath of stainless steel are presented. The measurements show that within the limits of measurement error the PED current is proportional to the neutron flux up to the maximum permitted thermal neutron flux having a density of 5 × 10 to the 13th power neutrons/sq cm sec. R.B.

N70-40620# Air Force Systems Command, Wright-Patterson AFB, Ohio. Human Resources Lab.

VIDEOTAPE AS A TOOL FOR IMPROVING HUMAN FACTORS TEST AND EVALUATION ACTIVITIES, JUNE–NOVEMBER 1969

Kenneth W. Potempa, Douglas R. Talcott, Susan S. Loy (McDonnell-Douglas Astronautics, St. Louis), and Noel F. Schwartz May 1970 16 p refs
(AD-708505; AFHRL-TR-70-6) Avail: NTIS CSCL 15/5

The document is concerned with how video-tape recordings (VTR) can be used to supplement or improve direct observation as a data collection method. The purpose was to make a thorough and systematic field study of how VTR can be used in evaluation of maintenance or operator activities in personnel subsystem testing and evaluation of new weapons systems. Author (TAB)

N70-40644*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A SPIN SYNCHRONOUS CLOCK FOR SPIN-STABILIZED VEHICLES

E. John Pyle Washington Sep. 1970 18 p
(NASA-TN-D-5960) Avail: NTIS CSCL 14B

The Spin Synchronous Clock (SSC) is a digital system that generates a time-based clock signal synchronized to the spin rate of a spin-stabilized vehicle. The basic function of the device is to supply a series of pulses defining equal angular intervals within the spin period. This function is accomplished by the generation of a signal whose frequency is a multiple of the spin rate. The clock signal may be synchronized to any spin event detected aboard the vehicle, such as the magnetic field crossing or the sun line crossing. The majority of scientific experiments on spin-stabilized spacecraft have directional detectors. Therefore, the spinning motion of the spacecraft causes these detectors to perform a circular scan of the celestial sphere. With an onboard clock synchronized to the spin rate and independent of telemetry format restrictions, the experimenter is free to sample data only from that region of space in which he is interested. Also, the SSC may be used to increase the accuracy and to reduce the complexity of other vehicle functions, such as attitude control, miniprobe separation, and electronically despun antennas. Author

N70-40733 National Lending Library for Science and Technology, Boston Spa (England).

A RADIOCRYSTALLOGRAPHIC APPARATUS FOR THE EXAMINATION OF IRRADIATED MATERIALS

J. Bloch 8 Jun. 1970 24 p refs Transl. into ENGLISH from CEA Report 1449
(NLL-LB/G/2877-(9091.9F); Rept-1449) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

To distinguish X-rays from beta and gamma radiation when measuring irradiated material, an apparatus was designed using the double diffraction method. A monochromotor is placed in the X-rays diffracted by the sample enabling lead shielding to be interposed between the sample and the counter. This eliminated a large proportion of the radiation due to sample activity. Using this method, substances with activities of the order of several tens of Curies may be examined. E.H.W.

N70-40757# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemistry.

ACCURATE MOLTEN SALT VISCOMETRY

A. Timidei, G. Lederman, and G. J. Janz Jun. 1970 21 p refs
(Contract N00014-67-A-0117-0006)
(AD-708719; TR-4) Avail: NTIS CSCL 14/2

The viscometer described in this note is of general applicability but its features are particularly suited for measurements with molten salts having appreciable vapor pressures and/or chemical reactivity to atmospheric moisture. While sealed viscometers are not unknown, the present design ensures a constant starting volume, and minimizes some of the inherent experimental difficulties, e.g., calibration, repeated measurements, and the kinetic energy and surface tension corrections. Magnitude and sources of errors are briefly considered, and results with this viscometer for KNO3 (m. 337C) HgC12(m. 277C, b. 304C), and CsNO3(m. 416C) are reported. Author (TAB)

N70-40790*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPARATIVE PERFORMANCE OF DOUBLE FOCUSED AND QUADRUPOLE MASS SPECTROMETERS
S. K. Wilson 1 Sep. 1970 25 p
(Contract NAS7-100)
(NASA-CR-113819; JPL-TM-33-456) Avail: NTIS CSCL 20F

A comparison is made of double focused and quadrupole mass spectrometers by analytical means. The analysis considers size, weight, and power for both types of instruments at identical resolutions and sensitivity for the same mass number. In the analysis, both instruments are used with equivalent ion sources having a 10-V voltage spread. It is shown that with weight and power the bases for comparison, the double-focused mass spectrometer is the better. Author

N70-40899 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS ON THE ROLE OF THE GELATIN IN THE PRECIPITATION OF PHOTOGRAPHIC EMULSIONS, PART 1
A. Narath et al May 1970 16 p refs Transl. into English from Photogr. Korresp. (Austria), v. 105, no. 4, 5, and 6, 1969 p 53-60, 69-76, and 93-105
(NLL-T-6170-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Nuclear and Lippmann emulsions were precipitated according to the continuous method. In the precipitation, effects occurred which are attributed to reactions between the gelatin and silver ions. In the investigations of the system gelatin/silver nitrate solution, it was concluded that the silver halide nuclei are formed at the polar areas of the gelatin macromolecules, and the hydrophilic polar areas are occluded by the growing grains. Primarily, insoluble gelatin-silver halide conglomerates originate which must be suspended by subsequent adsorption of gelatin. Reference is made to the general importance of these processes in the manufacture of photographic emulsions, and in the stabilization of the latent image. Author

N70-40917*# Rocketdyne, Canoga Park, Calif. Research Dept.
HYDROGEN LEAK AND FIRE DETECTION, A SURVEY
B. Rosen, V. H. Dayan, and R. L. Proffit Washington NASA 1970 88 p refs
(Contract NAS8-5604)
(NASA-SP-5092) Avail: NTIS CSCL 14B

The properties of hydrogen and hydrogen flame will be reviewed as background information for the discussion of detection techniques. Some of the hydrogen properties given also indicate both the usefulness and hazards associated with hydrogen. This review of properties is followed by an examination of methods and devices for detecting hydrogen and findings of recent research. A similar examination of hydrogen fire detection is also made. In addition to references from the text, a bibliography of related documents useful in the study of hydrogen safety and detection, is included. Author

N70-41002# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
A DEEP OCEAN NEPHELOMETER
P. B. Schuyler, D. S. Blomquist and J. J. Gilhooly Repr. from Mar. Technol. Soc. J., v. 4, no. 1, Jan.-Feb. 1970 p 61-64 refs
(Contract N00014-67-A-0377-0003)
(AD-708628; Rept-70-5) Avail: NTIS CSCL 14/2

An experimental nephelometer is described that is compact, independent of ambient temperature, easily deployed, battery operated, and capable of giving continuous in situ, real time measurements of turbidity in the deep ocean. The instrument has constant light intensity and gives repeatable readings under experimental conditions. Author (TAB)

N70-41019# Aerospace Corp., El Segundo, Calif. Lab. Operations.
DESCRIPTION AND CALIBRATION OF THE PROTON SPECTROMETER FLOWN ON SATELLITE 1969-25C (OV1-19), Report for October 1967-October 1969
John R. Stevens 1 Jun. 1970 47 p refs
(Contract F04701-69-C-0066)
(AD-708468; TR-0066(5260-20)-14; SAMSO-TR-70-225) Avail: NTIS CSCL 18/4

A proton spectrometer measures the directional differential flux of protons with energy from 0.18 to 2.81 MeV. The calibration of the proton energy thresholds and the count-rate meters are described. Background effects are also discussed. Background counting rates in the pulse-height analyzer caused by penetrating protons were negligible only if the energy spectrum of protons fell more rapidly than E to the -2 above E sub p = 10 MeV. The background counting rate due to low-energy electrons can be neglected only if the differential electron flux at 300-keV energy is < 1.2 million electrons/square cm-sec-sr-MeV. Corrections for background due to penetrating protons, low-energy electrons, and high-energy electrons are described in this report. Author (TAB)

N70-41093# Aerospace Corp., El Segundo, Calif. Lab. Operations.
MODIFICATIONS TO THE AEROSPACE LAMELLAR GRATING INTERFEROMETER, JUNE 1965-JANUARY 1970
Richard T. Hall, Charles M. Randall, and Jerome M. Dowling 20 Jun. 1970 20 p refs
(Contract F04701-69-C-0066)
(AD-709199; TR-0066(9260-01)-10; SAMSO-TR-70-232) Avail: NTIS CSCL 20/6

Several significant modifications have been made to The Aerospace Corporation lamellar grating interferometer. These modifications include the utilization of a tungsten coiled-coil source, the construction of an aluminum lamellar grating, and provision for external adjustment of the final mirror before the exit aperture. Two modifications are planned for the near future. These are the replacement of the Czerny-Turner mirrors by an off-axis paraboloid and the installation of a laser measuring system. These changes, accomplished and proposed, are discussed. Author (TAB)

N70-41120*# Geological Survey, Washington, D.C.
ULTRAVIOLET INSTRUMENTATION FOR ORBITAL REMOTE SENSORS
H. T. Betz (IIT Res. Inst., Chicago) Jun. 1966 42 p refs /its Tech. Letter NASA-31
(NASA Order R-146-09-020-008)
(NASA-CR-74516; TM-W6137-2) Avail: NTIS CSCL 20F

Candidate systems for a remote sensing experiment in lunar or earth orbit, operating in the ultraviolet region of the spectrum, are reviewed. The discussion includes: sensing reflected solar ultraviolet radiation; sensing of surface luminescence; and imaging of the surface in the ultraviolet. Because of suspected instrumental and interpretive difficulties, UV fluorescence and reflectance measurements have not been treated in any detail. Calculations indicate, however, that instruments can be built which will provide spectral and imagery data from orbital altitudes. H.S.W.

N70-41128*# Geological Survey, Washington, D.C.
TIME, SHADOWS, TERRAIN AND PHOTOINTERPRETATION
R. J. Hackman May 1966 29 p refs *Its* Tech. Letter NASA-22
(NASA Order R-09-020-013)
(NASA-CR-75770) Avail: NTIS CSCL 14E

Recent lunar studies have suggested that greater enhancement of the terrain is apparent on photographs taken at very low sun angle. To illustrate the effect of sun angle in the photointerpretation of aerial photographs, a plaster terrain model was photographed at 10 degree increments of illumination, ranging from 70 degrees to horizontal. The resulting photographs show that as the angle of illumination is decreased, tone differences become less apparent. In contrast, the enhancement, by shadow effect, of the topography, especially the micro relief (texture), becomes more apparent. Although most photographs presently used in photointerpretation studies are taken with high-angle illumination, this study suggests that photographs of the terrain at both high and low sun altitude would provide the greatest amount of terrain intelligence for the photointerpreter, and that if only one picture can be taken, one with the sun angle at approximate 30 degrees would be the most satisfactory in showing both tone difference and relief enhancement owing to shadows. Author

N70-41129*# Bureau of Mines, Pittsburgh, Pa. Energy Research Center.
DESIGN AND CONSTRUCTION OF A RADIATION PROBE
Cecil H. Schwartz and A. A. Orning Sep. 1970 23 p refs
(BM-RI-7427) Avail: NTIS

A thermal radiation probe was constructed and tested in pulverized coal-fired furnaces. A rotatable sensing head on the side of a water-cooled probe permitted measurement of radiant flux within a 7.2 deg cone from any desired direction to a point within a furnace. A response curve for a corner-fired furnace showed radiant flux of 130,000 Btu per sq ft per hr, when viewing flame, and 60,000 Btu per sq ft per hr, when sensing wall reflection. Detailed drawings and fabrication procedure are given. Author

N70-41141*# Geological Survey, Washington, D.C.
EVALUATION OF EKTACHROME AND MULTIBAND PHOTOGRAPHY IN CALIENTE RANGE, CALIFORNIA
J. G. Vedder and E. W. Wolfe Aug. 1966 11 p *Its* Tech. Letter NASA-17
(NASA Order R-09-020-015)
(NASA-CR-77081) Avail: NTIS CSCL 14E

Comparisons of geologic features outstanding in multiband and Ektachrome images are described for the aerial photography test area. It is concluded that aerial Ektachrome photography would be valuable in mapping unknown terrain with color contrast of rocks, but on-site inspection would be necessary. The multiband method could be used to discern specific geologic features and has promise as a remote sensing tool for rapid quantitative analysis of such features as sedimentary facies. J.M.

N70-41173*# College of the Holy Cross, Worcester, Mass.
REPLICA GRATING STUDY, PHASE 7 Interim Report, 1 Jul. 1969 – 30 Jun. 1970
Roy C. Gunter, Jr. 1 Jul. 1970 13 p
(Grant NGR-22-091-002)
(NASA-CR-113910) Avail: NTIS CSCL 20F

Particle irradiation tests were performed on concave gratings using a Dynamitron accelerator. The gratings were irradiated at levels of 3.6 × 10 to the 14th power and 3.6 × 10 to the 15th power e(−)/sq cm. At the lower irradiation level, a lowering of the efficiency of the gratings was observed, while any change in beamwidths at half and tenth power points fell within experimental error. At higher dosage, definite deterioration of some gratings was found and further lowering of grating efficiency was noted. Beta irradiation of plane Pyrex gratings and substrates by selected radioisotopes is included. An estimated dosage of 2.0 × 10 to the 15th power e(−)/sq cm at energy levels from 0.1 to 2.0 MeV produced no visible surface distortion upon interferometric examination. Author

N70-41175*# National Research Council of Canada, Ottawa (Ontario).
STABILITY OF STANDARD PLATINUM RESISTANCE THERMOMETERS BETWEEN 0 AND 630 C [STABILITA DI TERMOMETRI COMPIONE A RESISTORE DI PLATINO TRA 0 E 630 C]
S. Sartori 1970 6 p Transl. into English from Ric. Sci. (Rome), v. 36, no. 11, 1966 p 1276 – 1280
(NRC-TT-1414) Avail: NTIS

A standard resistance thermometer was constructed and compared with models from other laboratories and commercial sources. The characteristics of the constructed instruments are described with emphasis on the stabilizing elements and the accuracy with which the thermometer can be used to make measurements on the International Practical Temperature Scale of 1948, in which the instrument is used to interpolate between – 182.97 and 630.5 C. Author

N70-41197*# National Aviation Facilities Experimental Center, Atlantic City, N.J.
ALTIMETRY: A LITERATURE REVIEW AND BIBLIOGRAPHY, PHASE 1 Final Report
Jack J. Shrager Sep. 1970 104 p refs
(FAA-RD-70-52; FAA-NA-70-19) Avail: NTIS

The design, maintainability, and reliability of altimeter systems are presented in this review in an effort to promote safety and economy by the aviation community. The bibliography is annotated and has 259 items, an author's index is also provided. E.M.C.

N70-41218*# Massachusetts Inst. of Tech., Cambridge. Measurement Systems Lab.
TEMPERATURE READOUT SYSTEM FOR A STRAPDOWN GYRO SYSTEM
J. T. Egan Jun. 1970 58 p
(Contract NAS12-2085)
(NASA-CR-113899; RN-59) Avail: NTIS CSCL 14B

Results are presented of a program to investigate Inertial Measurement Unit (IMU) temperature control problems. A system was designed and built to monitor the complex temperature pattern of a strap-down IMU assembly while a thermal mock-up of the unit was undergoing environmental tests. Author

N70-41330* National Bureau of Standards, Boulder, Colo.
DENSITOMETER Patent
Charles E. Miller and Robert B. Jacobs, inventors (to NASA) Issued 17 Jan. 1967 (Filed 30 Dec. 1963) 6 p Cl. 73-62
Sponsored by NASA
(NASA-Case-XLE-00688; US-Patent-3,298,221; US-Patent-Appl-SN-334672) Avail: US Patent Office CSCL 14B

A device is described for measuring the density of single and two-phase cryogenic fluids. A section of the flow passage vibrated transversely at a constant amplitude and frequency is used as the sensing element. A dynamometer which connects the flow passage to a driving oscillator continuously measures the acceleration reaction of the fluid in the passage. Measuring the acceleration reaction, which is a product of mass and acceleration, indicates the fluid density in the passage. R.S.

N70-41332* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
MICROMETEOROID VELOCITY MEASURING DEVICE

Patent

William H. Kinard and Charles C. Laney, Jr., inventors (to NASA) Issued 3 Jan. 1970 (Filed 29 Mar. 1963) 7 p Cl. 324-70
(NASA-Case-XLA-00495; US-Patent-3,296,526; US-Patent-Appl-SN-269215) Avail: US Patent Office CSCL 14B

The described device consists of two micrometeoroid particle detectors located a known distance apart. Each of the particle detectors produces an electrical signal whenever a particle passes through the detecting element. The velocity of the micrometeoroids is determined from the time intervals between the signals produced by the detecting elements. R.B.

N70-41366* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

METHOD OF OBTAINING PERMANENT RECORD OF SURFACE FLOW PHENOMENA Patent

Kennedy F. Rubert, Allen R. Vick, Earl H. Andrews, Jr., and Charles B. King, inventors (to NASA) Issued 31 Jan. 1967 (Filed 14 Oct. 1964) 7 p Cl. 73-147
(NASA-Case-XLA-01353; US-Patent-3,301,046; US-Patent-Appl-SN-403960) Avail: US Patent Office CSCL 14C

A means of photographing the surface flow pattern produced on a wind tunnel test model by the oil smear technique is described. A mixture of oil and lampblack is applied to selected areas of a specific aerodynamic configuration. The model is subjected to the wind tunnel test, and afterwards a liquid vulcanizable elastomeric film is applied over the entire test surface. As the elastomeric film cures, it completely absorbs the oil smear and retains every minute detail of the flow pattern. The film is then stripped from the test model and is suitable for photographing. The model surface is simultaneously cleaned during the stripping. N.E.N.

N70-41445# Scientific Translation Service, Ann Arbor, Mich.

NEW THERMOELECTRIC TECHNIQUES FOR TEMPERATURE MEASUREMENT

J. Boyer et al Jun. 1970 20 p refs Transl. into ENGLISH from the French Paper Transl. for Argonne Natl. Lab.
(ANL-TRANS-828; CONF-700805-1) Avail: NTIS

A thermocouple indicates only the temperature of its junction. The comparison of the thermocouple's thermal level to that of the immediately adjacent medium so that this level is definable by a single value over the entire surface shared by the material and the junction is studied. The isothermal state of the junction and the thermal equilibrium of the thermocouple and the adjoining medium are discussed. The use of thermoelectric wires separately connected to the sample to reduce the response time for dynamic measurements of surface temperature is examined. Also, the possibilities of a temperature measurement in the wall of a liquid metal loop are discussed. NSA

N70-41448*# Carnegie Institution of Washington, D.C. Hale Observatories.

MODERNIZATION OF THE MOUNT WILSON 60-INCH TELESCOPE Final Report

Arthur H. Vaughan, Jr. Apr. 1970 15 p Prepared jointly by Carnegie Inst. of Washington, D.C. and California Inst. of Tech.
(Contract NSR-09-140-001)
(NASA-CR-113855) Avail: NTIS CSCL 17H

Digital coordinate readouts for right ascension and declination were installed in the Mount Wilson 60 in. telescope. Realignment of the telescope polar axis, overhauling of the main declination axis bearings, and installation of new coude spectrograph were completed. A computer controlled data acquisition system to work in conjunction with the telescope is reported 50 percent complete. J.A.M.

N70-41511# Atomic Power Development Associates, Inc., Detroit, Mich.

DESIGN, DEVELOPMENT, AND TESTING OF A TEMPERATURE COMPENSATED RHOMETER FOR MONITORING IMPURITIES IN SODIUM

W. D. Huston, J. E. Meyers, and C. C. Scott Apr. 1970 68 p refs
(Contract AT(11-1)-865)
(APDA-247) Avail: NTIS

The output of an automatically temperature-compensated rhometer, constructed and evaluated in the sodium test loop, exhibited short-term nonaccumulative, low-frequency oscillations of + or − 0.01% R, and a high-frequency noise level of + or − 0.005% R. Coefficients of the instrument's response to impurities such as sodium monoxide, sodium hydroxide, water, and hydrogen gas were measured. In parallel with the development of the automatically temperature-compensated rhometer, an extensive program was conducted to determine the response coefficients of a manually temperature-compensated rhometer to such other sodium impurities as sodium hydroxide, carbon monoxide, carbon dioxide, and inert gases, as well as to gamma radiation. The major components of the rhometer exhibited good maintenance-free histories. Concepts for a commercially packaged rhometer are presented, along with projected performance for such an instrument. Author (NSA)

N70-41556# Army Weapons Command, Rock Island, Ill. Research and Engineering Directorate.

APPLICATIONS OF HOLOGRAPHY TO COMPONENT TESTING

R. J. Iversen, J. W. McGarvey, and R. D. Schulz Jun. 1970 38 p refs
(AD-709603; AMSWE-RE-70-157) Avail: NTIS CSCL 14/2

Two new applications of holographic interferometry are presented. The first deals with the detection of bonding voids in rubber-to-metal, plastic-to-metal, and metal-to-metal laminates. The second application involves a new technique for the determination of the dimensional accuracy of cylinders, such as gun barrel bores. The methods used to detect laminate voids, including acoustical stressing and thermal stressing, are discussed, and results presented. The factors influencing the applicability of holography for barrel bore inspection are discussed, and computer programs used in the system design are included. Author (TAB)

N70-41620# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.

DEVELOPMENT OF A PULSE RADIOLYSIS DEVICE AND COMBINATION OPTICAL AND CONDUCTANCE DETECTOR OF SHORT-LIVED, CHARGED FREE RADICALS [ENTWICKLUNG EINER PULSRADIOLYSE-APPARATUR UND KOMBINIERTER OPTISCHER UND LEITFAEHIGKEITSNACHWEIS KURZLEBIGER GELADENER FREIER RADIKALE]

Gerhard Beck (Ph.D. Thesis) 1968 83 p refs In GERMAN
Avail: NTIS

The beam source for the pulse radiolysis device is a Van de Graaff generator with a sequential cycle between 0 and 1,000,000 pulses/sec of fast electrons at an energy of 1.6 MeV. Dosimetry is accomplished by using a secondary emission monitor. Calibration of the monitor with the help of chemical dosimetry is described. An apparatus for evaluation of extinction variations and a conductance measuring device are constructed on the basis of detecting the short-lived, charged free radicals. Interference of the conductance measuring device due to radicals charged by the beam and due to secondary emission in the analyzer is discussed. Transl. by R.B.

N70-41636# Vitro Labs., Silver Spring, Md.

ACOUSTIC MICROBUBBLE SPECTRUM ANALYZER CONTINUING EVOLUTION Technical Note, 8 Jan. 1969 – 15 Jun. 1970

William R. Turner 1 Jul. 1970 87 p refs

(Contract N00014-69-C-0143)
(AD-709466; TN-02242-01-1) Avail: NTIS CSCL 14/2

The spectrum analyzer instrument is intended to analyze insitu microbubble populations by detecting differential ultrasonic velocity and attenuation between a sea water sample and a reference liquid over continuous frequency range from 0.1 to 5.0 MHz. Particular problems addressed included further development of piston type quartz transducer to flatten its frequency response, modification to and repackaging of critical electronic circuits to reduce noise pickup and distortion, and an overall evaluation of the instrument to determine its present performance. While performance does not yet reach the desired goals, it is sufficient for the observation of microbubble phenomena, and indicates important potential for the instrument. Preliminary data are given and appraised in terms of microbubble physics. Author (TAB)

N70-41647* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENDLESS TAPE CARTRIDGE Patent
Kenneth W. Stark and William A. Burton, inventors (to NASA) Issued 3 Jan. 1967 (Filed 29 Oct. 1963) 5 p Cl. 242-55.19
(NASA-Case-XGS-00769; US-Patent-3,295,782; US-Patent-Appl-SN-319893) Avail: US Patent Office CSCL 14C

A cartridge having storage capacity for 1000 feet or more of endless-loop magnetic tape is described. The tape cartridge consists of a stationary roller mounting ring, an array of tape support rollers spaced about the ring, and a rotatable circular tape reel positioned concentrically to the mounting ring. The coiled tape pack is arranged about the reel with the bottom edges of the tape wraps resting on the tape support rollers. The rollers and the reel are both mounted in duplex bearings for idle rotation with respect to the stationary mounting ring. The reel and rollers are set in motion by the moving tape which is driven by a capstan positioned in the path of travel of the tape. R.B.

N70-41657# Aerospace Corp., El Segundo, Calif. Lab. Operations.
DOUBLE BEAMING IN FOURIER SPECTROSCOPY, JANUARY 1965 - JANUARY 1970
Jerome M. Dowling 21 Jul. 1970 68 p refs
(Contract F04701-70-C-0059)
(AD-709720; TR-0059(9260-01)-4; SAMSO-TR-70-244) Avail: NTIS CSCL 14/2

In two-beam interferometry, it is not the spectrum which is measured, but rather a quantity called the interferogram is obtained. The interferogram is related to the spectrum by a Fourier transformation. Because of this difference in what is measured there are a number of problems encountered in Fourier spectroscopy which are of no consequence in conventional single slit dispersive spectroscopy. One of these is the dynamic range problem, which can be very serious in absorption type Fourier spectroscopy. Another is the unfamiliar form the raw data (i.e., the interferogram) takes in Fourier spectroscopy. These and other problem areas are illustrated and remedial procedures discussed. Author (TAB)

N70-41673# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF A HIGH SENSITIVITY PIEZORESISTIVE SHOCK TRANSDUCER FOR THE LOW KILOBAR RANGE Final Report
Douglas D. Keough 25 Mar. 1970 85 p refs
(Contract DASA01-69-C-0014; ARPA Order 1238)
(AD-709438; DASA-2508) Avail: NTIS CSCL 14/2

The shock piezoresistance response of two metals, ytterbium and bismuth, was investigated--ytterbium over a range from 4 to 40 kbar and bismuth at 10 and 20 kbar. The sensitivity of both materials at a few kilobars is approximately 12 times that of manganin and both show nonlinear, monotonically varying resistance-stress behavior. Unloading response was measured at from 10 and 20 kbar in ytterbium and found to be nonlinear at the higher range. A positive residual resistance was measured which was essentially independent of peak stress. A system consisting of the impact of two elastic materials was developed for the measurement of hysteresis. Comparison of static and dynamic piezoresistance data indicates that the difference between the two is too large to be attributed to temperature and geometrical considerations. Author (TAB)

N70-41676* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPARATUS FOR PRODUCING THREE-DIMENSIONAL RECORDINGS OF FLOURESCENCE SPECTRA Patent
Myron M. Schachter, inventor (to NASA) Issued 31 Jan. 1967 (Filed 20 Feb. 1964) 7 p Cl. 250-71
(NASA-Case-XGS-01231; US-Patent-3,302,023; US-Patent-Appl-SN-346356) Avail: US Patent Office CSCL 20F

A spectrophotofluorometer, with three dimensional graph display, is described for measuring the fluorescence spectra of trace amounts of carcinogenic and similar noncarcinogenic hydrocarbons. An oscilloscope is connected to a conventional spectrophotofluorometer. An electric signal, obtained from the excitation monochromator, is proportional to the wavelength and is connected to the oscilloscope vertical deflection. A second signal, obtained from the emission monochromator, is also proportional to the wavelength and is connected to the horizontal deflection. A third signal, obtained from the photomultiplier tube, detects the intensity of the emission spectra and is connected to a trigger amplifier and oscillator which controls the beam intensity. The resulting fluorographs give specific information peculiar to each hydrocarbon. The fluorograph may be photographed at different intensity levels to produce a stereofluorograph when stacked. N.E.N.

N70-41681* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DYNAMIC SENSOR Patent
John Dimeff, inventor (to NASA) Issued 3 Jan. 1967 (Filed 21 Apr. 1965) 11 p Cl. 73-30
(NASA-Case-XAC-02877; US-Patent-3,295,360; US-Patent-Appl-SN-449902) Avail: US Patent Office CSCL 14B

A device for measuring the density or the pressure of a gaseous environment is described. The sensitive element is a vibrating member, preferably a thin, metallic diaphragm or an elongated ribbon, maintained at a constant vibrational amplitude under radial or axial tension. The gas to be measured fills a small, relatively enclosed space on each side of the vibrating member. The sensitive element is driven at the resonant frequency of the system by induced electrostatic forces applied between the vibrating member and a stationary unit to one side of it. The driving energy required to keep the system oscillating at a fixed amplitude is measured and related to the characteristics of the gas in the sensing volume. P.A.B.

N70-41682* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ANGULAR ACCELEROMETER Patent
Richard R. Richard, inventor (to NASA) Issued 3 Jan. 1967 (Filed 13 Jun. 1966) 8 p Cl. 73-517
(NASA-Case-XMS-05936; US-Patent-3,295,377; US-Patent-Appl-SN-557868) Avail: US Patent Office CSCL 14B

An accelerometer is described which is of relatively lightweight rugged construction with uncomplicated measuring circuitry. A sensing ring is secured at diametrically opposed points to a rigid support means which is fixed to the body subject to annular accelerations. A pair of masses supported on the ring are joined by a rigid connecting rod. The ring is also provided with strain intensification areas, produced by notches, in four locations equiangularly disposed about it. At each area, a strain gage is bonded to the sensing ring on its external surface; a corresponding

strain gage is attached to the inner surface. These gages are electrically connected in a bridge circuit arrangement which becomes unbalanced by variations in the electrical resistances of the gages when they are subjected to tension or compression forces. The imbalance is proportionate to the magnitude of angular acceleration.
P.A.B.

N70-41747# Los Alamos Scientific Lab., N.Mex.
DESIGN OF ROCKET-BORNE INSTRUMENT TO MEASURE FAR-INFRARED RADIATION IN THE NIGHT SKY
J. G. Beery, A. G. Blair, F. Edeskuty, R. D. Hiebert, D. M. Jones et al 10 Apr. 1970 27 p refs
(Contract W-7405-eng-36)
(LA-4357-MS) Avail: NTIS

A far-infrared radiation detection instrument, cooled by liquid helium and designed to be borne aloft by a Terrier–Sandhawk rocket, is described. The instrument responds to radiation in the following wavelength passbands: 6 to approximately 1.5 mm, 6 to approximately 0.6 mm, and 6 to approximately 0.1 mm. It has sufficient sensitivity to measure the proposed 2.7 K blackbody cosmic background radiation and significant deviations from the blackbody spectrum in the millimeter and submillimeter regions. Design features and operational characteristics of the instrument are described. Mating to the rocket, preflight preparations, parameters of the proposed flight, and postflight data handling techniques are also discussed.
Author (NSA)

N70-41799*# American Science and Engineering, Inc., Cambridge, Mass.
GRAZING-INCIDENCE TELESCOPES FOR CELESTIAL X-RAY ASTRONOMY USING AEROBEE ROCKETS Final Report
Jun. 1970 75 p
(Contract NASw-1758)
(NASA-CR-113911; ASE-2455) Avail: NTIS CSCL 17H

The Aerobee-150 payload which was flown on 6 February 1970 aboard NASA Flight 4.262CG at White Sands, N.M. is described. This payload contained a 9.5-inch X-ray telescope system for observing celestial objects. Also reported on is some basic research performed with optical surfaces, measuring their X-ray reflecting properties. This work will be useful in constructing future, improved telescopes. Finally, a design study is reported, in which a grazing-incidence telescope was incorporated into an Aerobee-350 payload. The only problem seen with this approach is the lack of precise roll-axis stabilization when using NASA's presently configured STRAP 3 pointing system in the offset mode. It is believed that this can be solved by adding a roll-axis stabilizer to the basic STRAP 3 system.
Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N70-40484# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
ON THE ACCURACY OF A THEORY OF HYDRODYNAMIC LUBRICATION IN COLD STRIP ROLLING
D. S. Bedi and M. J. Hillier Aug. 1968 25 p refs
(RR-12) Avail: NTIS

The theory of cold rolling with full fluid film lubrication is extended to cover a range of possible fluid film thickness distributions, the pressure coefficient of viscosity, and the effect of pressure gradient on lubricant shear stress. A best estimate of the actual film thickness distribution is made using a least energy principle. The effect of a range of possible simplifying assumptions on the accuracy of pressure distribution, roll load and roll torques is examined. It is found that the most appropriate lubricant film thickness distribution is of exponential type and that only roll torques are sensitive to simplifying assumptions. Pressures and roll loads may be estimated very closely by a simplified theory.
Author

N70-40518# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
THE DESIGN, MANUFACTURE, AND CALIBRATION OF SINTERED BRONZE POROUS PLATES FOR MASS AND HEAT TRANSFER
C. Watts and E. Brundrett Dec. 1969 37 p refs Sponsored by Natl. Res. Council
(TN-10) Avail: NTIS

The many workers in the field of mass transfer to a boundary layer have had difficulty in reducing the permeability variations in their porous surface. The effect of these variations which undoubtedly cause three dimensional effects near the plate surface is as yet unknown. For this reason porous plates were constructed, and a technique discovered which would reduce the permeability variation from + or − 20 percent to + or − 2 percent. The low permeability areas were milled on the back side of the plate, and the high permeability areas were pressed using a hydraulic press. The variation of + or − 2 percent was found to be independent of velocity. The correcting technique apparently did not affect the conductive heat transfer of the plates, and increased the uniformity of the heat transferred to the transpired gas.
Author

N70-40589# Avco Lycoming Div., Stratford, Conn.
FEASIBILITY STUDY OF COLUMBIAN ALLOY CASTINGS Quarterly Progress Report, 1 Nov. 1969 – 31 Jan. 1970
J. J. Walters Apr. 1970 57p ref
(Contract DAAG46-69-C-0163)
(AD-708920; Rept-2195.8.6; AMMRC-CR-70-5/2; QPR-2) Avail: NTIS CSCL 13/8

The quarterly progress report is the second in a series describing a program to determine the feasibility of investment-casting columbium alloys. Thirty-four castings are scheduled to be produced using consumable arc remelting and tungsten-lined molds to prevent mold-metal reaction. The Phase I program objective is to optimize the mold design and mold preheat temperature in preparation for the Phase II production of usable castings for mechanical and environmental testing. Five fluidity molds of alloy B-66 were produced, all in unheated molds with two, three, and four tungsten interface layers. In all cases the fluidity was poor, and obvious surface contamination was observed in the downsprues of the four-layer molds. The downsprue of the two-layer B-66 mold was contaminated throughout. Six fluidity castings of alloy WC-3015 were made with heated and unheated molds with two and three tungsten layers. Fluidity was improved by heating the molds and by reducing the number of tungsten layers.
Author (TAB)

N70-40597 National Lending Library for Science and Technology, Boston Spa (England).
ROUGH MACHINING OF STEEL USING CERAMIC CUTTING TOOLS [SCHRUPPBEARBEITUNG VON STAHL MIT OXIDKERAMSCHEN SCHNEIDWERKZEUGEN]
Ir. H. Thijssen 8 Jun. 1970 14 p refs Transl. into ENGLISH from Werkstatt Betrieb (Munich), v. 102, no. 2, 1969 p 79–82
In ENGLISH and GERMAN
(NLL-EE-Trans-1918-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The use of ceramic oxide cutting tools is investigated for turning steel at very high speeds. The fracture types, and their

causes are discussed. They include the following: (1) P-crack, (2) axial cleavage through the crater zone, and (3) rake surface fractures. Procedures recommended for avoiding these fractures are presented. The conditions that permit the use of ceramic cutter discs for high speed turning of steel using feeds of 2 mm/rev, a chip depth of 4 mm at speeds up to 400 m/min are given. F.O.S.

N70-40668*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRICTION AND CONTACT RESISTANCE FOR GALLIUM-LUBRICATED LOW-SPEED COPPER SLIPRINGS IN VACUUM
John Przybyszewski Washington Sep. 1970 22 p refs
(NASA-TN-D-5990; E-5663) Avail: NTIS CSCL 13I

Gallium was used as a lubricant for slipring assemblies (hemisphere contacting a flat) of OFHC copper or a beryllium-copper alloy that ran for 100 hr in vacuum at 1 rpm and carried a constant current of 20 A dc. The coefficient of friction was 0.2 to 0.3 for both materials, but the wear volume on each of the two OFHC Cu hemispheres used was at least 10,000 times greater than on the Be-Cu hemisphere. Both contact resistance and contact noise were low for the two materials. A noncontacting slipring assembly, using a Ga drop in a 0.5 mm gap, failed at 147 hr because of Ga drop disappearance. Author

N70-40694 National Lending Library for Science and Technology, Boston Spa (England).
CONTINUOUS CASTING OF NON-FERROUS METALS AND ALLOYS USING OPEN MOULDS
M. Bletschacher et al 29 May 1970 29 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 60, no. 9, Sep. 1969 p 684–693
(NLL-M-9156-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Continuous casting processes for nonferrous metals are discussed with open-end, and closed molds. Various types of molds in use are described and include molds which are independent of the furnace, and graphite molds. The mechanical properties of continuously cast and soft wrought metals are also discussed. F.O.S.

N70-40770*# Lamont Geological Observatory, Palisades, N.Y.
COMPOSITE DRILL STEM OF EPOXY FIBER GLASS REINFORCED WITH BORON FILAMENTS AND A RETRIEVABLE CORE LINER/SAMPLE RETURN CONTAINER FOR THE APOLLO LUNAR SURFACE DRILL
Marcus G. Langseth, Jr., Harry A. Gibbon, and Richard S. Perry Aug. 1970 80 p ref
(Contract NAS9-6037)
(NASA-CR-108640; Cu-2-70; TR-2) Avail: NTIS CSCL 13I

The development of a drill stem to be used with the Apollo lunar surface drill to drill holes in the moon's surface for emplacement of the lunar heat flow experiment is described, along with the subsequent development of a prototype model of a core retrieval system that does not require the removal of the drill stem from the lunar subsurface. Prototype models of a drill stem made of epoxy fiberglass, reinforced with axially aligned crystalline boron fibers, are described. A solid-face drill bit, 1.125 in. in diameter, was developed to be used with the boron filament stem. Author

N70-40807*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
USE OF THE COMPUTER IN DESIGN OF GAS TURBINE MAINSHAFT SEALS FOR OPERATION TO 600 FT/SEC (122 M/SEC)
L. P. Ludwig, J. Zuk, and R. L. Johnson 1970 37 p refs Presented at 26th Ann. Meeting of the Natl. Conf. on Fluid Power and the 10th Ann. Meeting of the Fluid Power Soc., Chicago, 13–15 Oct. 1970
(NASA-TM-X-52886; E-5917) Avail: NTIS CSCL 11A

Computer programmed analyses of the seal temperature field, elastic displacements, and seal force balance were used in an iterative design procedure to arrive at a final mainshaft seal design. For high speeds, temperatures and pressures in advanced engines, the sealing surfaces must not operate with rubbing contact. Hence, self-acting lift pads were incorporated to achieve positive separation of the sealing surfaces. A small gas film separating the sealing surfaces is achieved and the associated high gas-film-stiffness forces the seal nosepiece to dynamically track the runout motion of the seal face. Analysis revealed that the pressure profile across the sealing dam was significantly affected by sealing face deformation and that choked flows occur at a pressure ratio of greater than 4 to 1. The effect of this face deformation and choked flow was considered in establishing the seal force balance. To mitigate the effects of thermal deformation, it was necessary to structurally isolate the seat from the shaft. The role of the computer in the seal design is discussed. Tests confirm operation as predicted by the design analysis. Author

N70-40830# Aeroprojects, Inc., West Chester, Pa.
ULTRASONIC WELDING OF PS117 COPPER THIMBLES Final Report
John G. Thomas Mar. 1970 37 p refs
(Contract DAAG39-69-C-0032)
(AD-708934; HDL-0032-1; Rept-70-11) Avail: NTIS CSCL 13/8

Ultrasonic ring welding was investigated as a means for producing leaktight closures of PS117 copper thimble assemblies; these assemblies represent an advance design prototype of a fluoboric acid reservoir to replace the commonly used glass ampule as a fuze component. The drawn thimble cup has an annular geometry incorporating two concentric flanges to which the cover must be hermetically sealed. While the feasibility of simultaneous welding of both flanges using a concentric welding tip is the most economical and convenient procedure for production, considerable additional effort will be required to develop this technique. Hermetic seals of good burst strength were routinely produced at the outer diameter flange, but difficulty was experienced with the inner diameter flange when welding covers thicker than 0.010-inch. The problem was attributed to insufficient torsional amplitude at the small diameter flange. End-item use of the thimble assemblies reportedly requires covers of greater stiffness than 0.010-inch soft copper--possibly 0.012-inch hard temper or 0.016-inch soft temper stock. Several approaches involving equipment and/or assembly geometry modifications were evolved and recommended for future work to produce the required closure by the simultaneous welding technique. Author (TAB)

N70-40903*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH TEMPERATURE POLYIMIDE HYDRAULIC ACTUATOR ROD SEALS FOR ADVANCED AIRCRAFT
William R. Loomis, Robert L. Johnson, and John Lee (Royal Ind., El Segundo, Calif.) 1970 25 p refs Presented at Natl. Aeron. and Space Eng. and Manufacturing Meeting, Los Angeles, 5–8 Oct. 1970; sponsored by Soc. of Automotive Engr.
(NASA-TM-X-52889; E-5863) Avail: NTIS CSCL 11A

Findings are summarized of a program to design, develop, and evaluate actuator rod seals for use in advanced aircraft high-temperature hydraulic systems. The rod seals are intended to function efficiently and reliably for 3,000 hours in the temperature range of −40 to 500 F. Preliminary studies of various material and design combinations showed that a polyimide low-pressure second stage V-seal in a two-stage configuration had the greatest potential in long-term duty cycle testing in a simulated actuator test system. Modifications of this seal, that provided for improved fatigue life

and more efficient loading, met the test objectives of 20 × 1 million short-stroke cycles of operation at 500 F. Severity of this testing was equivalent to 3,000 hours of duty cycle operation. The validity of design techniques used to achieve performance goals was shown. Author

N70-41008# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
CHEMICAL STRENGTHENING OF Al2O3
John T. Jones and John T. Frasier (Babcock and Wilcox, Inc.) Nov. 1969 23 p refs
(Contract F33615-68-C-1034)
(AD-708707; ERI-62100) Avail: NTIS CSCL 11/2

Surface layers were chemically formed on sapphire and 99+% polycrystalline alumina specimens by annealing the samples while enveloped in various oxide powders. Quantitative observations were made by measuring the change in strength between the chemically treated specimens and those which were not chemically treated. The polycrystalline specimens were treated with Cr2O3, Co(x)O(y), Nb2O5, Fe2O3 or Cr2O3 + CrCl3. All treatments with the exception of Fe2O3 and Nb2O5 resulted in significant strength increases. Sapphire exhibited considerable strength increases when treated with Cr2O3 or Cr2O3 + CrCl3. Author (TAB)

N70-41090*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EVALUATION OF MICROBONDING TECHNIQUES USED IN HYBRID MICROELECTRONIC CIRCUITS
Salvadore V. Caruso 27 Mar. 1969 35 p ref
(NASA-TM-X-53823) Avail: NTIS CSCL 13H

Research data obtained from the production of hybrid microcircuits by three intraconnecting processes are presented. Parallel-gap welding, ultrasonic bonding, and thermocompression bonding processes were used to intraconnect gold and aluminum wires to thin films of gold, aluminum, and nickel. In some events, an alloy film of nickel and chromium was used with a film of gold or aluminum. One thin film consisted of a NiCr base deposition, a central deposition of molybdenum, and an external film of gold. Trial connections were made by each joining technique with various wire-to-film combinations to establish an optimum weld schedule by each respective process. Other specimens were produced by the respective weld schedules to determine the actual pull strength and bonding characteristics. Specimens were also subjected to environmental conditioning. Pull strength and visual observations were the criteria for evaluating each junction. Author

N70-41099*# Little (Arthur D.), Inc., Cambridge, Mass.
THE FEASIBILITY OF THE AUTOMATED VISUAL INSPECTION OF MICROCIRCUITS
David A. Curtis Jul. 1970 88 p
(Contract NAS12-2151)
(NASA-CR-113883) Avail: NTIS CSCL 14D

The experimental work performed is described, including the equipment, the theory of operation, and its use to obtain experimental results. The system is based on a comparison between two circuits, one being a master. Each circuit is scanned through an optical spatial filter using white light. The signal is then detected by a photo-detector, subtracted from the signal of the other circuit, and the differential signal compared with a set of decision criteria (at the simplest a fixed amplitude) to check for the presence of defects. Electrical noise does not cause problems in the operation of the gear, but measurement noise caused by translational and rotational misalignment, differences in intensity, and differences in focus between the channels set a limit on the minimum size of defect visible. Author

N70-41188*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FRICTION AND WEAR OF STEELS IN AIR AND VACUUM
Roamer Predmore, Jane Jellison, and Charles L. Staugaitis Washington Oct. 1970 21 p refs Presented at the Am. Soc. of Lubrication Engr., Aerospace Tech. Sessions, Chicago, May 1970
(NASA-TN-D-5916; G-983) Avail: NTIS CSCL 11F

Metal alloys were tested for sliding friction and wear characteristics in vacuum and in air. One purpose was the analysis of variations in the coefficient of friction with changes in air pressure, hardness, and type of alloy. Another purpose was the evolution of a scheme for description of wear patterns. With a Bowden–Tabor apparatus, sliders of various alloys were revolved in contact with a steel plate. Soft and hard steel, titanium, aluminum, copper, and copper-beryllium alloys were tested. Hardness of steel in the plate was varied. Visual and metallographic inspection, as well as study of microhardness traverses from below the wear interface, provided the results. Photomicrographs showing wear in the metal alloys are presented. Graphical descriptions of variations in the coefficient of friction are provided. A description of observed wear patterns is accomplished by a scheme of four categories: prow formation, severe rider wear, intermediate rider wear, and mild rider wear. In each category, wear pattern is correlated with a mechanism responsible for its formation. Author

N70-41232# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT AND EVALUATION OF HOT ISOSTATICALLY COMPACTED BORON NITRIDE Final Report, 20 Jan. 1969–15 Apr. 1970
M. C. Brockway and Dale E. Niesz Jul. 1970 29 p refs
(Contract DAAB07-69-C-0133)
(AD-709620; ECOM-0133-F) Avail: NTIS CSCL 11/2

The report discusses the development of hot-isostatic-compaction forming of BN which was initated in a prior study. Primary emphasis in the current program was on maximizing BN purity and therby minimizing its electrical loss. The experimental work also included limited study of the variation of BN properties with HIC process parameters. The uniqueness of the HIC process for forming BN is its relative freedom from shape limitations, its ability to yield a combination of high density, strength, and thermal conductivity combined with excellent electrical properties and only modest anisotropy. Author (TAB)

N70-41280# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
THE RANGE OF CAPACITY OF SEMIAUTOMATIC SHIELDED ARC WELDING WITH CARBON DIOXIDE [DER LEISTUNGSBEREICH BEIM HALBAUTOMATISCHEN SCHUTZGASSCHWEISSEN UNTER KOHLENDIOXYD]
Friedrich Wagemann (Ph.D. Thesis) 1968 415 p refs In GERMAN
Avail: NTIS

The economic possibilities of semiautomatic shielded arc welding with carbon dioxide are investigated with respect to mechanically-fed welding rods and direct current response. The advantages of semiautomatic shielded arc welding and the quality of the welded product are discussed. The studies show that a capacity of 9 to 12 kW, with a current of 320 to 360 amp, current flux density of 160 to 180 amp/sq mm, and voltage of 28 to 34 volts, is the optimum range. Using the recommended capacity, the technique is shown to be suitable for welded structures under static and dynamic stress and economically superior to manual welding. Transl. by R.B.

N70-41310* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PARALLEL MOTION SUSPENSION DEVICE Patent
Raymond A. McCreary, inventor (to NASA) Issued 3 Jan. 1967

(Filed 16 Apr. 1965) 4 p Cl. 248-178 Sponsored by NASA
(NASA-Case-XNP-01567; US-Patent-3,295,808;
US-Patent-Appl-SN-448898) Avail: US Patent Office CSCL 13I

Moveable suspension devices are described for measuring instruments, tools, and optical devices which require highly accurate movement along a precise axis for a short distance. A symmetrical arrangement of leaf springs in both an axial and a transverse plane is utilized. The device is symmetrical about two perpendicular axes and the forces are balanced and essentially friction free. An application to suspend an interferometer mirror is illustrated. N.E.N.

N70-41337# Sandia Labs., Albuquerque, N.Mex.
NEW VACUUM GLASS-FORMING MACHINE
K. D. Boultinghouse Sep. 1969 20 p
(SC-DR-69-331) Avail: NTIS

A new vacuum glass-forming machine with a unique traveling oven used to produce a quantity of small, precise glass parts or a single larger, more complex device is described. Developed originally to obtain the low-cost precision cases required for rolamite devices, this machine has applications in many other fields. Author

N70-41349# Technische Univ., Berlin (West Germany).
PRESSURE WELDING OF STEEL FOR THE MANUFACTURE OF TUBING FROM BANDS [UEBER DAS WARMPRESS-SCHWEISSEN VON STAHL UNTER BERUECKSICHTIGUNG DER ROHRHERSTELLUNG AUS BAND]
Manfred Sodeik (Ph.D. Thesis) 1968 122 p In GERMAN
Supported in part by Deut. Forschungsgemeinschaft
Avail: NTIS

Techniques for the manufacture of tubing from steel bands by pressure welding are discussed. The effects of temperature differences and pressure variations on the weld strength and mechanical properties of the tubing are described. The results of the research project are presented in graphs and charts. Transl. by P.N.F.

N70-41352# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
RESEARCH ON THE THERMAL BEHAVIOR OF ROTATING MACHINES WITH PARTICULAR CONSIDERATION OF THEIR CONFIGURATION [UNTERSUCHUNGEN UEBER DAS THERMISCHE VERHALTEN VON DREHMASCHINEN UNTER BESONDERER BERUECKSICHTIGUNG IHRER KONSTRUKTIVEN GESTALTUNG]
Bodo Dencker (Ph.D. Thesis) 1968 144 p refs In GERMAN
Avail: NTIS

The thermodynamic properties of rotating machinery with emphasis on heat generation and heat transfer are discussed. Time series analyses of the effects of rotational speed, length of time in operation, and the effects of loading are presented. The results of the research are presented in tables and graphs with appropriate mathematical models. Transl. by P.N.F.

N70-41371* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PORTABLE ALIGNMENT TOOL Patent
William J. Franklin and Neil C. Martin, inventors (to NASA) Issued 31 Jan. 1967 (Filed 30 Mar. 1964) 8 p Cl. 29-271
(NASA-Case-XMF-01452; US-Patent-3,300,847;
US-Patent-Appl-SN-356692) Avail: US Patent Office CSCL 13I

A portable device is described for aligning the surfaces of two adjacent wall or sheet sections so that the sections may be secured at the point of junction. The device consists of a clamping element adapted to contact the surfaces of the sections on one side, a second clamping element adapted to contact the opposite surfaces on the other side, and a thin flexible band extending between the clamping elements and through the joint formed by the opposed, contiguous edges of the two adjacent sections. After the sections are secured together, the alignment device is released from clamping by cutting the flexible band with a knife blade mounted on one of the clamping elements. R.B.

N70-41377*# Kentucky Univ., Lexington. High Temperature and Thermal Radiation Lab.
PREPARATION FOR AN INVESTIGATION OF THE THERMAL RADIATION CHARACTERISTICS AND THERMAL CONDUCTIVITY OF LUNAR MATERIAL Final Report, 1968
Richard C. Birkebak and Clifford J. Cremers Feb. 1968 44 p refs
(Grant NGR-18-001-026)
(NASA-CR-113931; TR-1) Avail: NTIS CSCL 14B

Work performed in the preparation of equipment and measurement techniques to be used on lunar material is described. An experimental study of the effects of sample size on the performance of the modified integrating sphere was carried out. The results indicate that the absolute reflectance can be obtained using the proposed displacement technique. Detailed studies of two techniques for the measurement of thermal conductivities were made and results obtained on a few simulated lunar materials. Author

N70-41378*# National Aeronautics and Space Administration, Washington, D.C.
NASA ANTI-POLLUTION EXPERIMENT
9 Aug. 1970 4 p
(NASA-News-Release-70-133) Avail: NASA Scientific and Technical Information Division CSCL 21G

Materials and design research problems are discussed for the development of a thermal reactor which would act as an automobile afterburner and replace standard exhaust manifolds. Work on combustion phenomena and reactor limits is also mentioned. E.C.

N70-41388*# Westinghouse Electric Corp., Baltimore, Md. Systems Development Div.
APOLLO COMMUNICATION SYSTEMS SUPPORT. TASK 8b-RF SPUTTERING SYSTEM, TASK 8c-HIGH OHMS/SQUARE RESISTIVE FILMS Final Report
Aug. 1970 16 p refs
(Contract NAS9-6636)
(NASA-CR-108610) Avail: NTIS CSCL 13H

Instructions are given for operating the RF sputtering system in conjunction with a CVC high vacuum evaporator and an RF power supply. A process for sputtering high ohms/square resistive films to form thin film resistors is described. Sample chromium disilicide resistors with aluminum contacts were fabricated and tested. Sintering before photoengraving resulted in chromium disilicide films which were not electrically continuous. Attempts to deposit the chromium disilicide film over a photoengraved aluminum pattern were unsuccessful, the CrSi2 being too thin to cover the steps in the aluminum. Four wafers were processed, the sheet resistances measured with a four point probe, and resistor measurements made by using an oscilloscope. The results show that chromium disilicide resistors having sheet resistances as high as 1000 ohm/square can be deposited by RF sputtering in argon. Devices annealed at 500 C in nitrogen exhibit an approximate doubling of resistance and a transition from a negative to a positive temperature coefficient of resistance. R.B.

N70-41489# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
SCANNING ELECTRON MICROSCOPY OF 6309 SIZE BEARINGS

Laurence Leonard and Gerald Cotellesse 31 Jul. 1970 53 p refs
(Contract N00014-70-C-0229)
(AD-709462; SKF-AL70C004) Avail: NTIS CSCL 13/9

The present research program is primarily concerned with a thorough study of bearing surfaces, both before and after running, with scanning electron microscopy (SEM) techniques. The SEM is a relatively new research tool whose application should lead to a much better characterization of surface initiated failure processes. Furthermore, since large surface areas can be conveniently studied, a more valid representation of bearing surfaces and their modifications with running should be obtained. This report covers the first phases of this research program. After a brief introduction on the SEM, a series of representative micrographs will be presented and briefly described. Then a discussion of the results to date will be presented. Finally, there will be an outline of further work on this current research program. Author (TAB)

N70-41507# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
THEORETICAL MODEL OBSERVATIONS AND EXPERIMENTS WITH THE HELP OF CHIP FORMATION PHOTOGRAPHY AS CONTRIBUTION FOR DESCRIBING THE DEFORMATION PROCESS DURING CHIP-FORMING MACHINING OF METAL MATERIALS [MODELLTHEORETISCHE BETRACHTUNGEN UND UNTERSUCHUNGEN MIT HILFE DER SPANWURZEL-MIKROGRAFIE ALS BEITRAG ZUR BESCHREIBUNG DES VERFORMUNGSVORGANGES BEI DER SPANENDEN BEARBEITUNG METALLISCHER WERKSTOFFE]
Gerhard Koehler (Ph.D. Thesis) 1968 166 p refs In GERMAN
Avail: NTIS

A theoretical two dimensional model and formation photographic studies of the metal chipping process are reported. Deformative chipping processes are represented by functional and disturbing formulas so that equations for the developing deformation structures depict the degree of deformation in correlation with other parameters of the chipping zones. Results show good agreement with photographic chip formation studies on several metallic materials. Transl. by G.G.

N70-41508# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
FRICTION AND WEAR OF PISTON RINGS AND CYLINDER BUSHINGS [REIBUNG UND VERSCHLEISS VON KOLBENRINGEN UND ZYLINDERBUCHSEN]
Dieter Baumgarten (Ph.D. Thesis) 1968 82 p refs In GERMAN
Avail: NTIS

Studies of destructive scalding lines show that developing heat favors the polymerization of lubricating oil components and thus affects the friction mechanism between piston ring and cylinder. Detergent containing lubricants that prevent the formation of varnish induce marked destruction of the friction surfaces. It is suggested that lubricants contain additives which form in a relative brief time a varnish layer on the involved friction surfaces and prevent abrasion. Transl. by G.G.

N70-41575 National Lending Library for Science and Technology, Boston Spa (England).
DETERMINATION OF THE POROSITY OF A LOOSE ASSEMBLY OF SPHEROIDAL PARTICLES FROM ITS STRUCTURE
G. M. Platonov May 1969 10 p refs Transl. into ENGLISH from Izd. Vyssh. Ucheb. Zaved., Ser. Chernaya Met. (USSR), No. 2, 1968 p 52–58
(NLL-LB-G-2858-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The structure formation in a loose assembly of spheroidal particles is investigated to determine the most probable paths for transfer from one form of structural formation to another. The studies show that the porosity of various structural forms of packing is independent of the particle diameter and the form of particle packing in one plane does not characterize the bulk structure of the layer. The porosity of a loose assembly of spheroidal particles varies over the limits of change in the sine of the angle from 90 to 45 deg, and its structural formation tends towards a closer packing by movement of the particles until they become stable. A sinusoidal law of change in the positional energy of the spheres determines the stability of the structural formations and porosity of the layer. Author

N70-41577*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD OF FORMING SUPERALLOYS Patent Application
John C. Freche, William J. Waters, and Richard L. Ashbrook, inventors (to NASA) Filed 20 Apr. 1970 10 p
(NASA-Case-LEW-10805-1; US-Patent-Appl-SN-29917) Avail: NTIS CSCL 13H

A method is described for obtaining a highly alloyed material by heating prealloyed powders to a superplastic state. Because of its particular microstructure, the material is easily shaped with relatively low pressures. Subsequent heat treatment restores the ability of the material to resist deformation at high temperatures. NASA

N70-41629* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CRYOGENIC CONNECTOR FOR VACUUM USE Patent
Philemon K. Platt and William T. Kitts, inventors (to NASA) Issued 31 Jan. 1967 (Filed 17 Nov. 1964) 4 p Cl. 285-331
(NASA-Case-XGS-02441; US-Patent-3,301,578; US-Patent-Appl-SN-411944) Avail: US Patent Office CSCL 11A

A leakproof seal for use in very high vacuum systems operating at cryogenic temperatures is described. A circular soft metal gasket is clamped between two circular connecting portions of a flange. Each member includes a series of ridges and grooves which are positioned to mate so as to deform the metal gasket between them. Each ridge on one member mated with a corresponding groove on the other member forms two sealing surfaces at each ridge-groove combination. R.B.

N70-41641# South Carolina Univ., Columbia. Coll. of Engineering.
POWDER METALLURGY COMPACTION Quarterly Progress Report, 1 Mar. – 31 May 1970
E. G. Schwartz, Kenneth L. Wilson, and James B. Hornsby 31 May 1970 13 p ref
(Contract AT(38-1)-475)
(SRO-475-7) Avail: NTIS

Results of die vibration experiments indicate that superimposed vibrations can reduce die wall friction during a compaction if the amplitude of vibration is great enough. The criterion for minimum amplitude appears to be the average particle size of the material being compacted. A previous survey characterized the powder used as being .00173 inches in diameter or less (84% of sample), and amplitudes of .001 to .006 inches were required to observe die wall friction reduction. NSA

N70-41648* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID STORAGE TANK VENTING DEVICE FOR ZERO GRAVITY ENVIRONMENT Patent
Solomon Stephen Papell and Robert W. Graham, inventors (to NASA) Issued 3 Jan. 1967 (Filed 13 Dec. 1963) 4 p Cl. 137-197
(NASA-Case-XLE-01449; US-Patent-3,295,545;

US-Patent-Appl-SN-330209) Avail: US Patent Office CSCL 13K

A venting device for a fluid storage tank is described in which the liquid and vaporous phases are separated by a magnetic force and the gaseous phase is vented into space. The movable valve element may be operated by pressure or by a solenoid device. R.B.

N70-41653# Los Alamos Scientific Lab., N.Mex.
FABRICATION OF NIOBIUM FLUIDIC CIRCUIT COMPONENTS BY DIFFUSION BONDING
R. S. Kirby Feb. 1970 5 p
(Contract W-7405-ENG-36)
(LA-4395) Avail: NTIS

A technique was developed for fabricating fluid circuit components by diffusion bonding chemically milled niobium foil laminates. Sections of 0.002 in. thick niobium foil were chemically milled to provide the correct channel pattern. The foil sections were then vapor coated with titanium and stacked in a diffusion bonding fixture. The laminated assembly was vacuum diffusion bonded at 1700 C by using an axial load of 300 to 500 psi, based upon the total assembly area. Author (NSA)

N70-41679* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
QUICK RELEASE SEPARATION MECHANISM Patent
William L. Newcomb, inventor (to NASA) Issued 7 Feb. 1967 (Filed 23 Dec. 1965) 7 p Cl. 102-49
(NASA-Case-XLA-01441; US-Patent-3,302,569; US-Patent-Appl-SN-516151) Avail: US Patent Office CSCL 13E

A mechanism is described which effects rigid coupling of the stages of an aerospace vehicle while permitting rapid and uniform separation at a predetermined signal. Pyrotechnic cutters operate with tensioning means to release a latching member, which permits disengagement of retainer and finger members by a compressed spring. The annular configuration of the mechanism permits utilization of the central space for various items; fail-safe redundancy may be provided by including a plurality of cutting elements and springs. Fragmentation and associated damage, as well as space debris, are substantially eliminated, as the parts remain attached to parent structures. P.A.B.

N70-41744# Israel Program for Scientific Translations, Ltd., Jerusalem.
MODERN ELECTROPLATING
V. I. Lainer 1970 312 p refs Transl. into ENGLISH of the book "Metallurgiya" Moscow, 1967 p 1–305 Sponsored by Dept. of Com. and NSF
(TT-69-55082) Copyright. Avail: NTIS CSCL 13H

The general principles of electrodeposition of metals and alloys, the tasks of individual electrolyte components, and the role of electric and thermal processes have been stressed rather than the composition of electrolytes. USGRDR

N70-41796# Minnesota Univ., Minneapolis. Physical Engineering Lab.
RESEARCH ON THE SPUTTERING OF MULTICOMPONENT MATERIALS BY ION BOMBARDMENT
G. K. Wehner May 1970 33 p refs
(Contract N00014-67-A-0113-0012)
(AD-709652) Avail: NTIS CSCL 11/6

Results are given of (1) a study of the cone formation which arises at the surface of a high sputtering yield target such as Cu when it is seeded during sputtering with another material such as Mo, and (2) the analysis of composition changes at the surface of multicomponent targets under ion bombardment and of sputter deposited films by means of in situ auger electron analysis. Author (TAB)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N70-40602# Aerospace Corp., El Segundo, Calif. Lab. Operations.
SPECTROSCOPY OF HF AND DF CONTINUOUS CHEMICAL LASERS, OCTOBER–NOVEMBER 1969
Munson A. Kwok, Robert R. Giedt, Theodore A. Jacobs, Rolf W. F. Gross, and Donald J. Spencer 1 Mar. 1970 13 p refs
(Contract F04701-69-C-0066)
(AD-708468; TR-0066(9240-01)-1; SAMSO-TR-70-226) Avail: NTIS CSCL 20/5

Continuous laser action has been observed on several HF and DF vibrational-rotational transitions. The HF lases between 2.8 and 2.9 microns, and the DF lases between 3.6 and 4.1 microns. The lines are identified and the relative intensities are shown. Author (TAB)

N70-40773# Stanford Univ., Calif. Microwave Lab.
TUNABLE OPTICAL SOURCES Progress Report, 1 Apr.–30 Jun. 1970
S. E. Harris, R. L. Byer, R. L. Herbst, and J. F. Young Jun. 1970 9 p
(Contract DAHC04-68-C-0048; ARPA Order-675)
(AD-708416; SU-ML-1866; PR-4) Avail: NTIS CSCL 20/5

An investigation was made of the various possible approaches of constructing a CdSe parametric oscillator tunable from 1.3 to 13 microns in the infrared. An experimental verification of this type of parametric oscillator is in progress. TAB

N70-40798# ARO, Inc., Arnold Air Force Station, Tenn.
VELOCITY MEASUREMENTS IN THE AEDC LOW SPEED WIND TUNNEL (V/STOL) USING A LASER DOPPLER VELOCIMETER Final Report
F. H. Smith and J. A. Parsons AEDC Jul. 1970 36 p refs
(Contract F40600-71-C-0002)
(AD-708717; AEDC-TR-70-119) Avail: NTIS CSCL 14/2

An in-house developed laser Doppler velocimeter (LDV) was used to make velocity measurements in a low speed wind tunnel. The installation and instrumentation are discussed, and velocity profiles obtained with the LDV are compared with those obtained using conventional techniques. A discussion on the factors which affect the accuracy of the LDV and improvements that would be desirable are also included. Author (TAB)

N70-40818# AVCO-Everett Research Lab., Everett, Mass.
LASER BEAM TRANSMISSION THROUGH THE ATMOSPHERE
J. Wallace, Jr. and M. Camac Mar. 1970 48 p refs
(Contract F29601-69-C-0060)
(AD-708896; AERL-RR-347) Avail: NTIS CSCL 20/5

Theoretical evaluation of the transmission of a laser beam at 10.6 microns has been investigated using the techniques of geometric optics. The interaction is non-linear because the refractive index depends through the mechanism of absorption, upon the intensity of the propagating wave. Atmospheric absorption at 10.6 microns is caused by CO_2 and H_2O in the atmosphere. Associated with absorption by CO_2 and transverse flow caused by atmospheric winds or beam motion are vibrational relaxation effects which can either heat or cool the atmosphere. If the atmosphere is cooled, the beam is self-focused. The velocity-altitude dependence of heating and cooling regimes are defined and detailed intensity distributions in each regime are presented. Author (TAB)

N70-40967*# IIT Research Inst., San Fernando, Calif. Aerospace/Optical Div.
SCANNING LASER RADAR FOR RENDEZVOUS AND

DOCKING
Terry Flom *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 237–277 refs (See N70-40951 23-31)
Avail: NTIS CSCL 20E

A description is presented of a laser radar system under development that has the capability of scanning its narrow laser transmitter beam simultaneously with an equally narrow receiver field-of-view without the use of mechanical gimbals. System performance characteristics and the general characteristics of size, weight and power are described. In addition, comments are made on the basic advantages of laser radar over microwave radar for spaceborne applications. A radar range analysis, for laser systems in general, indicates the basic capabilities of laser radar systems for both cooperative and noncooperative target applications. Graphs of target range versus required laser power for some particular rendezvous and docking problems are included. Author

N70-40988*# RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.
A LASER SYSTEM SUITABLE FOR SPACE APPLICATIONS
P. Schuddeboom, M. Teare, and D. Bennett *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 279–288 refs (See N70-40951 23-31)
Avail: NTIS CSCL 20E

Consideration of lasers for space applications includes: (1) the development of a small long-life sealed ceramic carbon dioxide laser tube, (2) the development of a simple laser frequency stabilizing control system which will operate over large excursions in cavity length in order to compensate for the effects of the change in refractive index with temperature of a GaAs modulator internal to the laser cavity, and (3) the development of a highly efficient laser power supply which does not require a ballast resistor. The operating characteristics of a laser stabilizing and control system are discussed. Author

N70-41003# ILC, Inc., Sunnyvale, Calif.
OPTICAL PUMPS FOR LASERS Triannual Report No. 1, 18 Sep. 1969–15 Jan. 1970
Lowell Noble and John Richter Jun. 1970 41 p refs
(Contract DAAB07-70-C-0035)
(AD-709618; ECOM-0035-1) Avail: NTIS CSCL 20/5

The overall objective of the report is to produce more efficient optical pumps for Nd:YAG lasers. The first task is the development of an alkali metal lamp for more efficiently pumping CW Nd:YAG lasers: 5% efficiency is the goal. The alkali metal spectra were investigated for effectiveness in exciting Nd:YAG. Potassium and rubidium each offer good possibilities. A potassium-filled lamp was stable and uniform. The second task is the development of a lamp for more efficiently pumping Nd:YAG lasers that operate at 10 pps with 10 joule electrical input to the fluorescent light output of Nd:YAG crystals, which is a direct function of the amount of pump light absorbed in the excitation bands of the crystal. For a fixed electrical input to the lamp, the fluorescent output provides a direct measure of relative optical pumping efficiency. It was found that a krypton lamp filled to 1500 torr pressure, operated with a critically damped current pulse, was 15% more efficient than the customarily used lamp which is filled to 450 torr with xenon. Author (TAB)

N70-41018# Maryland Univ., College Park. Dept. of Electrical Engineering.
THE STUDY OF THE INTERACTION OF INTENSE PICOSECOND LIGHT PULSE WITH MATERIALS Quarterly Technical Report, 18 Mar.–18 Jun. 1970
Chi H. Lee 18 Jul. 1970 38 p refs
(Contract DA-ARO(D)-31-124-70-G50; ARPA Order 675)
(AD-709703) Avail: NTIS CSCL 20/6

Topics discussed include two-photon conductivity effect and two-photon fluorescence effect from GaAs crystal with dye Q-switched Nd:glass laser. Third harmonic generation at total reflection of the primary beam of picosecond pulses is also discussed. Author (TAB)

N70-41199*# Yale Univ., New Haven, Conn. Dept. of Physics.
BUILD-UP OF LASER OSCILLATIONS FROM QUANTUM NOISE
M. Sargent, III (Ariz. Univ., Tucson), M. O. Scully (Ariz. Univ., Tucson), and W. E. Lamb, Jr. [1970] 23 p refs Supported in part by AFOSR and NSF
(Grant NGR-07-004-035)
(NASA-CR-113918) Avail: NTIS CSCL 20E

Build-up of laser oscillation is expressed in terms of the probabilities pn(t) that there are n photons in the laser cavity. These probabilities obey a coupled set of difference-differential equations of motion. The method and results of numerical integration of these equations are given here for the initial condition that no photons exist (radiation field vacuum). Corresponding equations of motion for the moments of the photon distribution are derived, and their time dependences are given. Author

N70-41237*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RAMAN BACKSCATTER OF LASER RADIATION IN THE EARTH'S ATMOSPHERE
Samuel Harvey Melfi (Ph.D. Thesis—Coll. of William and Mary.) Jul. 1970 163 p refs
(NASA-TM-X-66348) Avail: NTIS CSCL 20E

Laser optical radar techniques have been applied to the measurement of Raman backscatter in the atmosphere by nitrogen, oxygen, and water vapor. Ratios of the water vapor to nitrogen Raman return signals were compared to independent radiosonde measurements of water vapor mixing ratio. Initial experiments performed using a dual monochromator indicated good agreement to altitudes above 1 km. In later experiments, using interference filters, agreement was good to altitudes above 3 km, with some disagreement below 1 km. The disagreement below 1 km may be due to relatively intense aerosol scattering not totally blocked by interference filters used to select the Raman band. In addition, the ratio of the elastic scattered return to the nitrogen return signal was compared to the results of a balloon-borne dust photometer, with good agreement to above 3 km. Raman optical radar measurements of both water vapor and aerosol mixing agree with a qualitative analysis of turbulent mixing in the atmosphere. Author

N70-41261# Aerospace Corp., El Segundo, Calif. Lab. Operations.
CONTINUOUS WAVE CHEMICAL LASER CAVITY STUDIES, MAY 1969–JANUARY 1970
Donald J. Spencer, Henry A. Bixler, and Donald A. Durran 30 Jul. 1970 25 p refs
(Contract F04701-70-C-0059)
(AD-709202; TR-0059(6756-01)-1; SAMSO-TR-70-255) Avail: NTIS CSCL 20/5

Three techniques developed in laser studies relating to continuous wave chemical laser cavity design, analysis, and development are discussed. These three techniques are (1) a laser cavity mirror absorptivity measurement, (2) a gain distribution measurement, and (3) a tunable cavity mirror configuration. Author (TAB)

N70-41345# Technische Univ., Berlin (West Germany).
A HIGH RESOLUTION PROCESS FOR MEASURING ELECTRON DENSITY [EIN HOCHAUFLOESENDES

VERFAHREN DER ELEKTRONENDICHTE-MESSUNG MITTELS LASERINTERFEROMETRIE]
Wolfgang Schaller (Ph.D. Thesis) 1968 114 p refs In GERMAN
Avail: NTIS

The application of laser interferometry to the measurement of electron density is discussed. The measuring equipment consists of an unmodulated laser which illuminates an interferometer with spherical mirrors. The interferometer contains a high vacuum diode as a space charge source. The laser and interferometer are so arranged that the frequency of the laser corresponds to the point of inflexion of the permeability curve of the interferometer. When the space charge is energized across the frequency range of the interferometer, an amplitude modulation of the penetrating light rays occurs. With a photodiode as a receptor, an alternating voltage is produced by which the electron density is measured. Transl. by P.N.F.

N70-41383# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
CALCULATION AND EXPERIMENTAL COMPARISON OF ELECTRON DENSITY AND RADIATED POWER FOR ION LASER TRANSITIONS IN A WALL-STABILIZED, LOW PRESSURE, LARGE-DIAMETER ARC COLUMN [BERECHNUNG UND EXPERIMENTELLER VERGLEICH VON BESETZUNGSDICHTEN UND STRAHLUNGSLEISTUNGEN FUER IONENLASERUEBERGAEUNGE IN DER WANDSTABILISIERTEN NIEDERDRUCKBOGENSAEULE MIT GROSSEM DURCHMESSER]
Wolfgang Seelig (Ph.D. Thesis) 1969 92 p refs In GERMAN
Avail: NTIS

A theoretical study of the power amplification process is conducted in which the electron density of the laser levels is determined from the balance equation for the power gain. The atomic parameters are replaced directly by the measured values of the gas discharge, after which the electron density is then given as a function of current intensity, tube geometry, and gas pressure and compared with experimental data. The construction of a continuous wave ion laser is described and the experimental results obtained with the device are compared with calculated results. Transl. by R.B.

N70-41387*# Florida Technological Univ., Orlando.
PROPAGATION AND CONFINEMENT OF LIGHT BEAMS Final Report, 15 Mar. 1968 - 1 Aug. 1970
Harvey N. Rexroad 1 Aug. 1970 204 p refs
(Grant NGR-10-019-001)
(NASA-CR-113806) Avail: NTIS CSCL 20E

The material presented includes the results of a research program on the subject of laser optics. The specific areas involved in the study are reported under the following headings: (1) theory of optical resonators; (2) the self consistent field equations of optical resonators; (3) the waveguide approach; (4) partially coherent polychromatic light; and (5) practical laser optics. D.L.G.

N70-41452# National Materials Advisory Board, Washington, D.C.
FUNDAMENTALS OF DAMAGE IN LASER GLASS
Jul. 1970 88 p refs
(Contract N00014-67-A-0244)
(AD-709421; NMAB-271) Avail: NTIS CSCL 11/2

In spite of the fact that substantial amounts of money have been expended by both industry and the military, optically induced damage in glasses still limits the usefulness of laser-glass devices. It is believed that the existing material limitations are not insurmountable. It is therefore desirable to evaluate and review the efforts in various industrial and governmental laboratories to define the fundamental material limitations and to indicate steps in research and development necessary to reach those fundamental limits. The report outlines the several problems that need to be overcome to permit production of a laser glass having a damage threshold of 100 joules per sq cm while possessing the other qualities requisite for good high-durability laser glass. A program directed toward the solution of these problems is documented in the report. Author (TAB)

N70-41525*# Raytheon Co., Lexington, Mass.
AN APPARATUS FOR RESTORING OPTICALLY DEGRADED LASER OPTICS Patent Application
George A. de Mars, inventor (to NASA) Filed 1 Oct. 1968 7 p
(Contract NAS12-548)
(NASA-Case-ERC-10210; US-Patent-Appl-SN-764236) Avail: NTIS CSCL 20E

A gas laser comprising an optical cavity with a lasing medium in the longitudinal portion is described. An optical mechanism is provided at the end of the longitudinal portion for reflecting radiation back into the optical cavity. A device is provided for sputtering the end of the optical cavity with the lasing medium to remove the radiation absorbing film which accumulates on the optical terminating surfaces of the cavity. NASA

N70-41578* Hughes Aircraft Co., Culver City, Calif.
SOLID STATE CHEMICAL SOURCE FOR AMMONIA BEAM MASER Patent
Morton Robinson, inventor (to NASA) Issued 22 Nov. 1966 (Filed 24 Jan. 1964) 5 p Cl. 331-94 Sponsored by NASA
(NASA-Case-XGS-01504; US-Patent-3,287,660; US-Patent-Appl-SN-340113) Avail: US Patent Office CSCL 20E

An apparatus is described in which the ammonia is stored in a form from which it can be slowly released at a controllable rate, by means of its conversion to a silver chloride complex salt. Means are provided for regulating the temperature of the ammonia salt reservoir at a predetermined level so that the salt dissociates and liberates gaseous ammonia through a passage into the maser at a predetermined pressure. The solid state source may be separated from its vapor by a screen with openings smaller than the particle size of the solid. The source may thus be utilized in any position, such as for in-flight satellite maser operation. P.A.B.

N70-41601# Rensselaer Polytechnic Inst., Troy, N.Y.
THE HCD ARGON ION LASER
W. C. Jennings, J. H. Noon, E. H. Holt, and R. G. Buser (Inst. for Exploratory Res.) Fort Monmouth, N.J. ECOM Jun. 1970 51 p refs
(Contract DAAB07-67-C-0533)
(AD-709592; ECOM-3289) Avail: NTIS CSCL 20/5

The operating characteristics of two different argon ion laser systems are described. In the mode of operation where only an axial magnetic field confines the hollow cathode discharge (HCD), it is an inefficient energy source for lasing. However, when discs are introduced to radially restrict the arc to the dimension of the central aperture of the discs, the HCD laser is shown to perform almost identically to a conventional argon ion laser employing a heated cathode. Technological advantages of the HCD laser are discussed. The experimental data obtained are compared with calculations based on a theoretical analysis predicting output power as a function of gas pressure. The increasing influence of electron-ion interactions at high currents is clearly demonstrated. The effects of radiation trapping are also considered. Author (TAB)

N70-41604# Oregon Graduate Center for Study and Research, Portland.
MULTIWAVELENGTH LASER PROPAGATION STUDY, 2 Final Interim Report, 16 Jun. 1969 - 15 Jun. 1970
J. Richard Kerr Jul. 1970 62 p refs
(Contract N00014-68-0461-0001; ARPA Order 306)
(AD-709458; Rept-1154-8) Avail: NTIS CSCL 20/6

A comprehensive, multiwavelength laser-beam propagation

facility was operated over a horizontal, 1 mile path in order to investigate the adequacy of the commonly-used atmospheric model and to establish the wavelength-dependence of scintillations. The optical measurements included log amplitude variances, covariances, scintillation spectra, probability distributions, and receiver and transmitter aperture effects. The microthermal measurements included turbulence spectra, critical scales, and temperature probability distributions. It was found that the inertial subrange model constitutes only an approximation to the true turbulence structure, and that the inner scale is often nonnegligible. The prevalence of quasi-discrete inhomogeneities in the refractive index structure constant was verified, and the consequent difficulty in relating nonoptical strength of turbulence measurements to actual scintillations is pointed out. In spite of these inadequacies in the atmospheric model, it was found that the unsaturated multiwavelength scintillations compared reasonably well with theoretical predictions when based on the turbulence as determined from scintillations of a short-path, portable laser. Also, there was no indication of saturation of longer wavelengths at low variances relative to those for visible wavelengths. These are other tentative conclusions are discussed in detail. Author (TAB)

N70-41683# Army Electronics Command, Fort Monmouth, N.J. Inst. for Exploratory Research.
DETERMINATION OF ATMOSPHERICALLY INDUCED PHASE FLUCTUATIONS BY LONG DISTANCE INTERFEROMETRY AT 6328 A
Rudolf G. Buser and Gunthard K. Born May 1970 21 p refs
(AD-709579; ECOM-3283) Avail: NTIS CSCL 20/5

Experimental values of atmospherically induced phase fluctuations have been obtained for various pathlengths using a near-ground horizontal Mach-Zehnder setup at 6328 A. Independent determination of the structure function constant of the refractive index and other relevant parameters permitted a clear definition of prevailing meteorological conditions. It is found that for low turbulence, or strong turbulence and short pathlength, Tatarskii theory generally under-estimates the values of the observed rms phase fluctuations. For higher turbulence no continuous phase information is directly obtainable, and the concept of phase structure function becomes experimentally undefined. Author (TAB)

N70-41776# Temple Univ. Research Inst., Philadelphia, Pa.
THE INVESTIGATION OF THE USE OF HIGH BRIGHTNESS FLAMES AS A POSSIBLE SOURCE FOR PUMPING SOLID LASER RODS Final Report, 29 Jan. 1969 – 30 Apr. 1970
Charles S. Stokes 30 Apr. 1970 32 p refs
(Contract DAAA21-69-C-0365)
(AD-709698; GL-1970-8) Avail: NTIS CSCL 20/5

As a follow on to previous research on the use of the cyanogen-oxygen gaseous detonation system as a method to pump both ruby and neodymium-glass laser rods, a study was initiated to investigate the possibility of using high-brightness flames as light sources to pump laser rods in a continuous mode. The use of solid additives to the flames such as aluminum oxide, zirconium oxide, and neodymium chloride were investigated as to the possibility of increasing the light output either as a whole or selectively. The study included the investigation of the cyanogen-oxygen and aluminum-oxygen flames. Using as standards of comparison light sources which have been used to pump YAG-neodymium laser rods, it was possible to evaluate the feasibility of proposed systems to pump such rods. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N70-40410 Rice Univ., Houston, Tex.
STRESS RELAXATION STUDY OF MONOCRYSTALS OF SOME BCC METALS AND ALLOYS
Donald Herbert Coplin (Ph.D. Thesis) 1969 174 p
Avail: Univ. Microfilms; HC $8.00/Microfilm $3.00 Order No. 69-19277

A comprehensive study of the effects of strain, temperature, and dilute alloy concentration was made on tantalum and molybdenum single crystals. Stress relaxation experiments were used to evaluate the thermal activation parameters. The solute used was rhenium in atomic concentrations of less than 10%. Each crystal was alternately strained and allowed to relax. The data were analyzed by fitting the relaxing stress, tau, to the time, t, equation tau = A-kT/V ln(t+C) where A and C are constants and V is the activation volume. The activation energies were found to be the same for all the metals and alloys tested. The addition of rhenium caused the activation volumes to increase. The temperature dependence of the flow stress decreased with rhenium content in the tantalum alloys. The "effective" structural stress was found to have nearly the same temperature dependence as the flow stress. Dissert. Abstr.

N70-40464# Stanford Research Inst., Menlo Park, Calif.
THE OXIDATION MECHANISM OF ZIRCONIUM Final Report, 15 May 1967 – 14 May 1970
Francis J. Keneshea 24 Jun. 1970 5 p
(Contract DAHC04-67-C-0055)
(AD-708573; AROD-7098.2-MC) Avail: NTIS CSCL 11/6

The report summarizes research carried out on the following scope of work: Determination of the oxygen deficiency in ZrO(2-x) in equilibrium with oxygen-saturated Zr; Studies of the diffusion of oxygen in zirconia, and a test of the applicability of the results to theoretical models of the defect structure; Determination of the oxygen deficit at which the mole fractions of free electrons and anion vacancies are equal. TAB

N70-40471# Royal Aircraft Establishment, Famborough (England).
GRAIN SIZE AND MECHANICAL PROPERTIES [KORNGROESSE UND MECHANISCHE EIGENSCHAFTEN]
Eckard Macherauch (Karlsruhe Univ. (West Ger.)) Mar. 1970 50 p refs Transl. into ENGLISH from Z. Metallk. (West Ger.), v. 59, no. 8, 1968 p 669–686 Presented at the Grain Size of Non-ferrous Metallic Semi-finished Prod. Symp., Frankfurt, 19 Oct. 1967
(RAE-Lib-Trans-1413) Avail: NTIS

This survey first makes some general points on grain boundaries in mechanically stressed polycrystals. Then, with the aid of selected examples, the effects are discussed of changes of grain size on quantities that can be obtained from simple tests in a mechanical investigation of materials. After a discussion of the grain boundary influence on hardness measurements, the effects of grain size on dynamic tensile tests are expounded. Comments are made on the behaviour of work-hardening curves, micro-strains, elastic limits, and flow stresses of fcc, bcc, and hcp materials, of different grain size. The brittle fracture phenomena for bcc metals are discussed. Finally, some examples are considered of the different behaviour of materials with various grain sizes in fatigue and creep. Author

N70-40489 Rice Univ., Houston, Tex.
THE SUPERCONDUCTIVITY OF MOLYBDENUM
Daltro Garcia Pinatti (Ph.D. Thesis) 1969 112 p
Avail: Univ. Microfilms; HC $5.60/Microfilm $3.00 Order No. 69-19328

Electrodynamic damping is proved to be the main controller of the transitions curves, and the trapped flux was shown to be concentrated in the center of the sample in a rather diffuse way. Supercooling properties were studied, and a decrease of the KAPPA factor with annealing time was established. KAPPA factors

as low as .075 + or − .02 were obtained. A method of residual resistivity measurement using the dynamic technique is exploited, and agreement with the potentiometric method is found. An approximate method of solution of the Ginsburg–Landau equations for an isolated vortex is studied. Final mathematical expressions for the parameters involved are found. Expressions for the differential and incremental entropy of a vortex are deduced, and agreement with experimental behavior is found. Forces due to thermal and order parameter gradients are computed from which a mechanism of flux expulsion is suggested. Dissert. Abstr.

N70-40521# Aerospace Corp., El Segundo, Calif. Lab. Operations
Ti-Be COMPOSITES PRODUCED BY THE CO-EXTRUSION OF POWDERS Research Report, Jun. 1968–Jan. 1969
Dennis L. Dull, George E. Kendall, and Louis Raymond 15 Apr. 1970 32 p refs
(Contract F04701-69-C-0066)
(AD-708716; TR-0066(5250-10)-20; SAMSO-TR-70-235) Avail: NTIS CSCL 11/4

The results of the investigation demonstrate that a new family of Ti-Be co-extruded, powdered metal composites can be added to the inventory of high specific-strength/modulus, fracture-resistant materials used for weight-critical design applications. Preliminary experimental data have shown that these two highly reactive metals can be consolidated into a composite stable to 810K (1000F) with a microstructure that cannot be developed by conventional melting practices. Microprobe analysis and X-ray diffraction showed that no detrimental beryllides were formed during processing. Potentially, this new system could compare to the Al-50 v/o B composites. Currently, a composite with the modulus of steel and the density of Al is commercially available. Author (TAB)

N70-40543# Watervliet Arsenal, N.Y. Benet R and E Lab.
THE BAUSCHINGER EFFECT IN COPPER AND COPPER-ZINC ALLOYS
Vincent R. Milligan and William H. Koo May 1970 13 p refs
(AD-708561; WVT-7022) Avail: NTIS CSCL 11/6

A series of five different copper-zinc polycrystalline alloys, ranging from commercially pure copper to 65% Cu 35% Zn brass, were strained various amounts up to 5% in tension and reverse strained in compression. The Bauschinger strain is shown to be dependent on composition. An equation relating plastic strain and the Bauschinger effect is presented and experimentally verified. Preliminary data shows that the Bauschinger strain is dependent on grain size for the 65% Cu 35% Zn alloy, but is independent of grain size for the OFHC copper. Author (TAB)

N70-40575 Pittsburgh Univ., Pa.
A STUDY OF THE FACTORS THAT CONTRIBUTE TO THE STRENGTH OF TEMPERED 9 PERCENT NICKEL STEEL
Gerald Joseph Spaeder (Ph.D. Thesis) 1969 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-18384

The flow strength of quenched and tempered 9% nickel 0.1% Several techniques were used to determine quantitatively the volume factions of the phases present in the structure as a function of tempering time (in the range 1/2 to 2400 hours) and temperature (900 to 1250 F). Because the strengths of the phases present in the structure are also a function of tempering time and temperature (because of the change in the composition of the austenite that occurs during tempering), microhardness measurements were used to determine the strengths of the individual phases. Light, and transmission electron metallographic techniques were employed to follow the microstructural changes that occur during tempering. The results showed that to a first approximation, the overall flow strength of the tempered steel is a linear function of the product of the volume fraction of the individual phases present in the structure and the flow strength of the phase. Dissert. Abstr.

N70-40580 California Univ., Berkeley.
PREPARATION, PHASE TRANSFORMATION, AND MAGNETIC PROPERTIES OF VERY FINE COBALT PARTICLES
Chung-Ming Hsieh (Ph.D. Thesis) 1969 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-18933

Extremely low dislocation and stacking-fault densities were found in ultrafine cobalt particles. The phase transformation from face-centered-cubic to hexagonal close-packed on cooling is strongly particle-size dependent; ultrafine particles contain not more than 0.1% hexagonal phase. The critical size range of single-domain cobalt particales was determined by coercive force measurements and nuclear magnetic resonance. Ultrafine cobalt particles were prepared by (1) electrode-position into mercury, (2) evaporation in an argon atmosphere, and (3) reduction of cobalt oxide in a high-surface-area substrate. The size distribution of the particles was measured by precision X-ray diffraction and was confirmed by means of the electron microscope. The phase transformation of ultrafine cobalt particles is martensitic. Dissert. Abstr.

N70-40599 California Univ., Los Angeles.
MECHANISMS OF ENVIRONMENTAL EMBRITTLEMENT, THE INFLUENCE OF OXYGEN ON NICKEL-BASE ALLOYS
Martin Prager (Ph.D. Thesis) 1969 302 p
Avail: Univ. Microfilms: HC $13.75/Microfilm $3.90 Order No. 69-17565

A study was made of the embrittling effects of oxygen on Rene' 41, a precipitation hardenable, nickel-base alloy. Tensile and crack growth studies were conducted in the range of temperatures from 1375 to 1700 F. It was found that tensile ductility of Rene' 41 decreases as the oxygen content of the environment increases. Also, in air, cracks propagate at stresses well below the yield strength. Crack initiation and propagation are intergranular in the presence of oxygen but transgranular in inert atmospheres. Sensitivity to oxygen is affected by heat treatment, grain size, and, indirectly, composition. It is shown that the problem of strain-age cracking in fabrication is related to environmental embrittlement, and that other nickel-base alloys are also embrittled by oxygen. Dissert. Abstr.

N70-40735*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DETERMINATION OF WELDABILITY AND ELEVATED TEMPERATURE STABILITY OF REFRACTORY METAL ALLOYS. 3: EFFECT OF CONTAMINATION LEVEL ON WELDABILITY OF REFRACTORY METAL ALLOYS
D. R. Stoner Washington NASA Sep. 1970 111 p refs
(Contract NAS3-2540)
(NASA-Cr-1609; WANL-PR-(P)-015) Avail: NTIS CSCL 11F

The tolerance of three highly weldable tantalum and columbium alloys to in-service oxygen contamination and subsequent repair welding was investigated. The alloys evaluated were FS-85, T-111, and T-222. These alloys were surface oxidized at low oxygen partial pressure and subsequently vacuum annealed to diffuse the oxygen contamination throughout the material. The detrimental effects of oxygen contamination were measured by bend tensile and restrained weld tests. Five oxygen contamination levels, ranging from residual oxygen content to 1000 ppm, were selected for this investigation. In addition, T-111, was aged for 1000 hours under ultra-high vacuum conditions to evaluate the effect of oxygen contamination on the thermal stability of base and weld metal. All three alloys exhibited a reasonable tolerance for contamination up to 100 to 200 ppm oxygen, above which ductility impairment became excessive. T-111 proved to be the most tolerant to oxygen contamination. The thermal history had a greater effect on the mechanical properties of T-111 than total oxygen content, apparently

by altering the form and distribution of the oxide precipitates. Weld metal mechanical properties were nearly equal to base metal properties over the range of oxygen contamination investigated. Author

N70-40747# Boeing Co., Renton, Wash. Commercial Airplane Group.

STRESS INDUCED TRANSFORMATIONS IN TiMo ALLOYS

Martin J. Blackburn and John A. Feeney Feb. 1970 15 p refs
(Contract N00014-66-C-0365)
(AD-709048; D6-25210) Avail: NTIS CSCL 11/6

The deformation characteristics of the metastable beta alloy Ti-11.5Mo-6Zr-4.5Sn (Beta III) have been studied. In the range -196 to +150C, Beta III deforms primarily by mechanical twinning and to a lesser extent by slip and stress-induced orthorhombic martensite formation. Author (TAB)

N70-40750# Boeing Co., Renton, Wash. Commercial Airplane Group.

EFFECT OF MICROSTRUCTURE ON THE STRENGTH TOUGHNESS, AND STRESS-CORROSION CRACKING SUSCEPTIBILITY OF A METASTABLE BETA TITANIUM ALLOY Ti-11.5Mo-6Zr-4.5Sn

John A. Feeney and Martin J. Blackburn Feb. 1970 51 p refs
(Contract N00014-66-C-0365; ARPA Order 878)
(AD-709049; D6-24472) Avail: NTIS CSCL 11/6

The paper describes the influence of microstructure on the mechanical properties of the alloy Ti-11.5Mo-6Zr-4.5Sn. The phase transformations are similar to those that occur in binary Ti-Mo alloys containing 10% to 12% Mo. Thus the beta-phase can be retained by quenching from above 1400F. The beta-phase deforms in a complex manner, including mechanical twinning, and is characterized by low strength, high ductility, and high toughness. The omega-phase, which also forms on quenching, is stable at temperatures up to 800F. Yield strengths of up to 220 ksi have been measured in (beta + omega) structures, the strength level being dependent on the size and volume fraction of the omega-phase. Unfortunately, the best combinations are susceptible to stress-corrosion cracking in aqueous solutions containing halide ions. Author (TAB)

N70-40754# Boeing Co., Renton, Wash. Commercial Airplane Group.

EFFECTS OF RESIDUAL STRESSES ON STRESS CORROSION CRACK GROWTH RATES IN ALUMINUM ALLOYS

Michael V. Hyatt Nov. 1969 23 p refs
(Contract N00014-66-C-0365; ARPA Order 878)
(AD-709051; D6-24469) Avail: NTIS CSCL 11/6

Stress-corrosion crack growth rate data obtained as a function of the plane-strain stress intensity using double cantilever beam specimens of 7079, 7075, and 7175 are presented. The effects of quenched-in residual stresses on crack growth rates in specimens of this design are discussed, and methods of eliminating the residual-stress problem are presented. Author (TAB)

N70-40755# Boeing Co., Renton, Wash. Commercial Airplane Group.

EFFECT OF QUENCHING RATE ON STRESS-CORROSION CRACK GROWTH RATES IN 2024 T4 ALUMINIUM

Michael V. Hyatt Nov. 1969 12 p refs
(Contract N00014-66-C-0365; ARPA Order 878)
(AD-709050; D6-24471) Avail: NTIS CSCL 11/6

Stress-corrosion crack growth rates in double cantilever beam specimens of 2024-T4 aluminum quenched at two rates from the solution-treatment temperature were compared. The specimens quenched at the slower rate had the faster crack growth rate. This finding agrees with data from other studies in which intergranular corrosion susceptibility was determined by measuring percent loss in tensile strength of preexposed sheet tension specimens. Author (TAB)

N70-40839# Boeing Co., Seattle, Wash. Commercial Airplane Group.

EFFECT OF GRAIN REFINEMENT ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF 434OM

Donald Webster Apr. 1970 23 p refs
(Contract N00014-66-C-0365; ARPA Order-878)
(AD-709045; D6-25220) Avail: NTIS CSCL 11/6

A new grain refinement technique involving grain boundary pinning by deformation voids has been investigated in 434OM steel. Significant grain refinement is observed in deformed specimens at all temperatures between Ac1 and 50F above Ac3. In a narrow temperature region just above Ac3, grain refinement produces an increase in strength and toughness but no increase in stress-corrosion threshold. It is concluded that to take full advantage of the new grain refinement process, compositional modifications of 434OM type steels are required. Author (TAB)

N70-40840# Boeing Co., Seattle, Wash. Commercial Airplane Group.

STRESS-CORROSION PROPERTIES OF HIGH-STRENGTH PRECIPITATION-HARDENING STAINLESS STEELS IN 3.5% AQUEOUS SODIUM CHLORIDE SOLUTION

Clive S. Carter, Dana G. Fenwick, Alan M. Ross, and Jack M. Uchida Feb. 1970 35 p refs
(Contract N00014-66-C-0365; ARPA Order-878)
(AD-709044; D6-25219) Avail: NTIS CSCL 11/6

The plane-strain fracture toughness and stress-corrosion threshold have been determined for high-strength, precipitation-hardening steels. Author (TAB)

N70-40900# Boeing Co., Renton, Wash. Commercial Airplane Group.

EFFECTS OF SPECIMEN GEOMETRY AND GRAIN STRUCTURE ON STRESS-CORROSION CRACKING BEHAVIOR OF ALUMINUM ALLOYS

Michael V. Hyatt Nov. 1969 25 p refs
(Contract N00014-66-C-0365; ARPA Order-878)
(AD-709046; D6-24470) Avail: NTIS CSCL 11/6

Effects of side grooves, grain structure, and thickness on the growth behavior of stress-corrosion cracks in double cantilever beam (DCB) specimens of aluminum alloys are discussed briefly. Problems encountered in testing DCB specimens from aluminum die forgings are also discussed. Author (TAB)

N70-40908# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.

PHASE RELATIONS IN THE ALKALINE EARTH FLUORIDE-YTTRIA SYSTEMS 2: THE BaF2-Y2O3 PHASE DIAGRAM

Laurance L. Oden, Philip E. Sanker, Herbert R. Babitzke, and Donald H. Sumner Oct. 1970 10 p refs
(BMRI-7438) Avail: Issuing Activity

Liquidus and solidus temperatures and solid solubilities were determined for the BaF2-Y2O3 system, and the information is presented as the phase diagram. The phase diagram was constructed from data obtained by ceramography, X-ray diffraction, and thermal analysis of specimens encapsulated in small molybdenum ampoules. The data indicate a simple eutectic system with maximum terminal solid solubilities of less than 1 mole pct. The eutectic temperature is 1,343 C, and the composition of the eutectic is less than 1 mole pct Y2O3. Author

N70-40909# Boeing Co., Renton, Wash. Commercial Airplane Group.
USE OF PRECRACKED SPECIMENS IN SELECTING HEAT TREATMENTS FOR STRESS-CORROSION RESISTANCE IN HIGH-STRENGTH ALUMINUM ALLOYS
Michael V. Hyatt Nov. 1969 21 p refs
(Contract N00014-66-C-0365; ARPA Order-878)
(AD-709043; D6-24467) Avail: NTIS CSCL 11/6

Three techniques using precracked double cantilever beam (DCB) specimens were employed to measure resistance to stress-corrosion crack propagation as a function of the degree of overaging in the alloy 7075. Two techniques used single DCB specimens containing aging gradients along their lengths. The third technique used multiple DCB specimens, each one having a different heat treatment. All three techniques gave similar results, but stress-corrosion resistance as a function of heat treatment was determined most rapidly using separate DCB specimens having different heat treatments. Data from this study suggest that DCB specimens would be useful in several other stress-corrosion study areas, including that of thermomechanical treatments for aluminum alloys. Author (TAB)

N70-40926# Boeing Co., Renton, Wash. Commercial Airplane Group.
USE OF PRECRACKED SPECIMENS IN STRESS-CORROSION TESTING OF HIGH-STRENGTH ALUMINUM ALLOYS
Michael V. Hyatt Nov. 1969 58 p refs
(Contract N00014-66-C-0365; ARPA Order-878)
(AD-709047; D6-24466) Avail: NTIS CSCL 11/6

Resistance to stress-corrosion cracking of 10 high-strength aluminum alloys in a variety of heat-treatment conditions was measured using precracked double cantilever beam (DCB) specimens. A new technique is described, and stress-corrosion crack growth rates for the alloys tested are presented as a function of the plane-strain stress intensity K(I). Double cantilever beam specimen data correlated with established trends from smooth specimens tested by alternate immersion in 3.5% NaCl solution. From the crack growth rate data and the speed and simplicity with which it is obtained, it is concluded that the DCB specimen will be highly useful for (1) comparing and rating alloys, (2) developing new alloys and heat treatments, (3) comparing the effects of environments, (4) achieving or ensuring product uniformity, and (5) studying mechanisms of cracking. Author (TAB)

N70-40944# Columbia Univ., New York. Henry Krumb School of Mines.
DISLOCATION DYNAMICS AND THE DEFORMATION OF ALPHA-BRASS
Narayana Balasubramanian May 1970 131 p refs
(Contract DA-31-124-ARO(D)-382)
(AD-708903; AROD-5642-6-MC) Avail: NTIS CSCL 11/6

Plastic deformation has been studied in a series of four compositions of alpha-brasses. Experiments were designed to test the consistency of several indirect methods of determining the dislocation velocity-stress exponent, m^*. Plastic zone propagation has been studied for the first time in f.c.c. materials and explained in terms of dislocation dynamics. The concept of activation area has been restricted to low temperature deformation. The applicability of this concept to high temperature deformation has been established. The activation areas for creep deformation have been calculated and examined in the light of many material and deformation variables. The activation areas for grain boundary sliding in Al, Pb, Sn, Zn, and Cu are compared with those for creep in the same materials. Author (TAB)

N70-40980*# Boeing Co., Seattle, Wash. Aerospace Group.
INVESTIGATION OF CRACK GROWTH THRESHOLD OF INCONEL 718 EXPOSED TO HIGH PRESSURE OXYGEN
Final Report 24 Apr.–25 May 1970
C. F. Tiffany, J. N. Masters, and W. D. Bixler Aug. 1970 99 p refs
(Contract NAS9-10913)
(NASA-CR-108485) Avail: NTIS CSCL 11F

Fracture and subcritical flaw growth characterisitics were experimentally determined for forging and electron beam (EB) welded inconel 718 tankage material in environments of high pressure gaseous and liquid oxygen. Static fracture, sustained load, cyclic load, and combined sustained/cyclic load tests were conducted using precracked surface flawed specimens. Specimen thicknesses, welding and heat treating procedures, and environments were selected to simulate those of either the Apollo Service Module/Electrical Power System (SM/EPS) LOX tank or the Lunar Module/Environmental Control System (LM/ECS) GOX tank. For both tanks, the failure mode was found to be leakage proof at operating stress levels, and no environmentally induced subcritical flaw growth was observed. In addition, cyclic flaw growth rates at stress levels and stress ratios applicable to the SM/EPS LOX tank are essentially zero. Author

N70-41048*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
SURVEY OF ELECTRICAL RESISTIVITY MEASUREMENTS ON 8 ADDITIONAL PURE METALS IN THE TEMPERATURE RANGE 0 TO 273 K
L. A. Hall and F. E. E. Germann Aug. 1970 87 p refs
(NASA Order R-06-006-046)
(NASA-CR-113877; NBS-TN-365-1) Avail: NTIS; SOD $1.00 CSCL 11F

Experimental electrical resistivity data for 8 pure metals have been compiled, tabulated, and graphically illustrated for a temperature range of 0 to 273 K. A section has been prepared for each particular metal which includes references, brief comments concerned with preparation of sample, purity, and any other pertinent information, tabulated data, and graphs. Author

N70-41096# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
AN ANALYSIS OF INTRINSIC DIFFUSION AND INTERDIFFUSION IN SINGLE PHASE BINARY DIFFUSION COUPLES
John W. Patterson Aug. 1969 19 p refs Submitted for publication
(Contract F33615-68-C-1034)
(AD-708633; ERI-528) Avail: NTIS CSCL 20/12

The Matano method and Darken method for deducing interdiffusion coefficients and intrinsic diffusion coefficients are reexamined. It is shown that the coordinate system with the Matano interface as origin is inconsistent with Boltzmanns analysis. An alternative coordinate system with origin at the weld interface is proposed and is used to rederive the formulas for interdiffusion coefficients and intrinsic diffusion coefficients in terms of marker displacements and concentration profile data. The new formula for the interdiffusion coefficient has not been pointed out previously but the formulas deduced for the intrinsic diffusion coefficients are identical with results deduced independently by Heumann. Author (TAB)

N70-41187*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF STRAIN-GAGE ATTACHMENT BY SPOTWELDING AND BONDING ON FATIGUE BEHAVIOR OF Ti-6Al-4V, RENE 41, AND INCONEL X
L. A. Imig Washington Oct. 1970 22 p refs
(NASA-TN-D-5973; L-7165) Avail: NTIS CSCL 11F

An experimental investigation was conducted to evaluate the effects of spotwelding and bonding, as used for instrumentation

attachment, on the fatigue behavior of three alloys suitable for use in high-speed airplanes: a titanium alloy and two superalloys. The effects of spotwelding were evaluated by means of constant-amplitude fatigue tests conducted at room temperature for all three alloys and at 1500 F for the superalloys. Test results for the titanium alloy indicated much lower fatigue strengths for specimens having strain gages attached by spotwelding than for plain specimens. The superalloys were affected similarly but to a lesser extent. The losses of fatigue strength were attributed to local microstructural changes due to spotwelding. In contrast, specimens with strain gages attached by adhesive bonding had fatigue strength equal to that of smooth specimens. Author

N70-41188# Alabama Univ., University. Bureau of Engineering Research.

AN EVALUATION OF TOUGHNESS OF HEAT TREATED ALLOY STEELS BASED UPON ENERGY DISSIPATIONS Final Report

Edward J. Planz May 1970 39 p refs
(Contract DAAH01-69-C-1150)
(AD-709697) Avail: NTIS CSCL 11/6

An instrumented impact machine was utilized to evaluate the toughness of materials both in the as received and heat treated conditions. A correlation existed between portions of the oscilloscope traces obtained from Charpy v-notched impact specimens and standard tensile threaded specimens with regard to mechanical properties such as ultimate tensile load and % elongation in 1 inch. In addition, with an additional modification of the instrumented impact machine a correlation was shown to exist between the oscilloscope traces of v-notched tensile impact specimens and v-notched tensile threaded specimens with regard to ultimate tensile loads. The time response to fracture of ferrous materials should be included in evaluating the toughness of materials and should be considered before recommending ferrous materials for critical utilization. As an alternative one may employ the complete stress-strain curve. Author (TAB)

N70-41255# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.

THE FIELD EMISSION OF IRONS [DIE FELDEMISSION DES EISENS]

Ernst-Ludwig Richter (Ph.D. Thesis) 1968 67 p refs In GERMAN
Avail: NTIS

Measurements of the field emission of iron are discussed. Procedures for determining the chemical and physical properties of iron based on field emission are described. Chemical reactions, spectrographic measurements, thermodynamic properties, and photomicrographs of the crystalline structure of iron are presented. Transl. by P.N.F.

N70-41293# Technische Univ., Berlin (West Germany). Fakultaet fuer Bergbau und Huettenwesen.

INVESTIGATING THE AGING BEHAVIOR OF STEELS DURING GRADUAL DEFORMATION [UNTERSUCHUNGEN UEBER DAS ALTERUNGSVERHALTEN VON STAEHLEN BEI STUFENWEISER UMFORMUNG]

Peter Munk (Ph.D. Thesis) 1968 147 p refs In GERMAN
Avail: NTIS

The technological relationship between a specimen being formed and the temperature-time ratio induced by multistage tools or presses is investigated. The change in the technological characteristics of commercial-grade steels suitable for cold working under artificial and natural aging conditions, corresponding to prevailing temperature-time ratios of multistage presses, are discussed. It is shown that strain hardening processes strongly affect the strength features, in that they anticipate certain portions of hardening such that the flow curves exhibit a smoother pattern than in the unaltered state. Transl. by R.B.

N70-41319# Technische Univ., Berlin (West Germany).

ON THE CORROSION OF LOW ALLOYED STEELS IN CO2-CO-Ar AND CO2-CO-Ar-SO2 ATMOSPHERES AT HIGH TEMPERATURES [UEBER DIE KORROSION VON NIEDRIGLEGIERTEN STAEHLEN IN CO2-CO-AR UND CO2-CO-AR-SO2 ATMOSPHAEREN BEI HOHEN TEMPERATUREN]

Joerg Holland (Ph.D. Thesis) 1968 95 p refs In GERMAN
Avail: NTIS

The effects of alloying elements on iron scaling is interpreted by thermodynamic reactions and diffusion behavior. Carbon content decreases corrosion velocity in all alloys somewhat whereas carbon dioxide and sulfur dioxide further corrosion. Alloying element effects on the reaction kinetics of scaling are determined by the following properties: (1) variable diffusion ranges at high temperatures; and (2) differing affinities towards oxygen or sulfur. Transl. by G.G.

N70-41344# Technische Univ., Berlin (West Germany).

CONTRIBUTION TO THE MECHANICAL ACTIVATION OF TITANIUM MAGNETITE [BEI TRAG ZUR MECHANISCHEN AKTIVIERUNG VON TITANOMAGNETIT]

Eberhard Gock (Ph.D. Thesis) 1968 50 p refs In GERMAN
Avail: NTIS

Vibratory grinding of an olivine enriched titanium magnetite for 320 hours produced an almost complete pulverization of the titanium components. This pulverization behavior established the relationship between grinding equilibrium and grinding limitations. After a certain grinding period at constant pressure, a pulverization limit is reached that represents a stationary phase between mechanical activation and surface modification properties. Proof is provided for a recrystallization during the grinding process. Transl. by G.G.

N70-41348# Technische Univ., Berlin (West Germany).

THE RELATIONSHIP BETWEEN ADHESION AND ELECTRON STRUCTURE OF METALS WITH ROLLING FRICTION IN THE ELASTIC REGION [UEBER DEN ZUSAMMENHANG ZWISCHEN ADHAESION UND ELEKTRONENSTRUKTUR VON METALLEN BEI DER ROLLREIBUNG IM ELASTISCHEN BEREICH]

Horst Czichos (Ph.D. Thesis) 1968 83 p refs In GERMAN
Supported in part by Deut. Forschungsgemeinschaft
Avail: NTIS

The relationship between adhesion and the electron structure of metal surfaces during rolling friction is discussed. Energy losses, coefficients of friction, and volume absorption are described for cases of similar and dissimilar metals in sliding and rolling contact. The effects of plastic deformation, elastic hysteresis, and surface properties are presented. Several theories of friction mechanics are provided. Transl. by P.N.F.

N70-41359# Technische Univ., Berlin (West Germany). Fakultaet fuer Bergbau und Huettenwesen.

A CONTRIBUTION TO THE RESEARCH OF THE ELECTRONIC PROPERTIES OF CARBON IN gamma IRON AND NICKEL [EIN BEITRAG ZUR UNTERSUCHUNG DER ELEKTRONISCHEN EIGENSCHAFTEN DES KOHLENSTOFFS IN gamma-EISEN UND NICKEL]

Achim Bauldom (Ph.D. Thesis) 1968 62 p refs In GERMAN
Avail: NTIS

The Hall effect and specific electrical resistance for solutions of gamma iron and nickel are presented. The thermodynamic properties related to carbon content are described. Electronic reactions in a Hall field showed that no electron transport occurs. It is determined that the electronic effects of carbon in gamma iron and nickel are negligible. Transl. by P.N.F.

N70-41361# Technische Univ., Berlin (West Germany). Fakultaet fuer Bergbau und Huettenwesen.

THE CAUSE OF FERRITE EMBRITTLEMENT IN

IRON-SILICON-CARBON ALLOYS [DIE URSACHE DER FERRITVERSPROEDUNG BEI EISENSILIZIUM-KOHLENSTOFF-LEGIERUNGEN]
Horst Weiss (Ph.D. Thesis) 1968 122 p refs In GERMAN
Avail: NTIS

The causes and resulting physical properties of ferrite embrittlement in iron-silicon-carbon alloys are discussed. The microstructures of the compounds and their thermodynamic properties are presented. The results of the research are described in tables and graphs. Transl. by P.N.F.

N70-41382# Technische Univ., Berlin (West Germany). Fakultaet fuer Bergbau und Huettenwesen.
THE DIRECT CURRENT EFFECT IN ZONE MELTED TUNGSTEN CRYSTALS [DER GLEICHSTROMEFFEKT AN ZONENGESCHMOLZENEN WOLFRAMKRISTALLEN]
Peter Adam (Ph.D. Thesis) 1968 92 p refs In GERMAN
Avail: NTIS

The characteristics of dislocations and deformation, as well as crystal orientation, are investigated in zone melting of drawn tungsten crystals, which have a 110 grain texture and a constant crystallographic orientation with the planes of the 110 zone near the free surface. The predominance of surface or volume diffusions in crystal formation is considered. The question of whether the transport energy itself causes periodic ordering of gable facets or whether such facets develop only with the help of transport energy is considered for the case when there is the possibility of purely thermal facet growth. Transl. by R.B.

N70-41456*# Battelle Memorial Inst., Columbus, Ohio.
A NEW ALUMINUM SAND CASTING ALLOY OF HIGH TOUGHNESS (M-45)
R. A. Wood Washington NASA 1970 34 p refs Sponsored by NASA
(NASA-SP-5091) Avail: SOD $0.40; NTIS CSCL 11F

A technical review is given of the status of the M-45 alloy, as well as a forecast of possible uses of the material. The purpose is to provide information that researchers, designers, and engineers can use to: (1) further study and evaluate the alloy; (2) elucidate the unique characteristics and properties of the material and identify any difficulties in working with it; and (3) select applications in which the alloy can be used effectively. Author

N70-41460# National Science Foundation, Washington, D.C.
CORROSION OF METALS: METHODS OF INVESTIGATION
V. V. Romanov 1969 228 p refs Transl. into ENGLISH from the Russian
(TT-69-55038) Avail: NTIS CSCL 11F

The work includes a description, generalization, and analysis of the existing methods of investigation of corrosion of metals. In addition to a description of new devices and investigation methods, an attempt has been made in this book to generalize the reference data found in various monographs and handbooks on corrosion of metals. Author (USGRDR)

N70-41494# Clemson Univ., S.C.
[ON RADIATION DAMAGE IN METALS] Progress Report
R. L. Chaplin Apr. 1970 13 p refs
(Contract AT(40-1)-3098)
(ORO-3098-13) Avail: NTIS

Research efforts have resulted in an improved method for growing very thin single crystal samples of aluminum, proved that radiation damage of single crystals of aluminum depend upon sample thickness as well as crystallographic orientation, shown that some type of complex defects exist in pure aluminum which is irradiated with electrons of 0.4 MeV, studied the influence of radiation damage and the annealing for aluminum that is doped with copper, begun computer calculations of vacancy and divacancy migration for comparison with experimental data for aluminum samples, obtained results from single crystal samples of magnesium, and found one method by which the low temperature annealing stage of magnesium can be understood. It is believed that these results make a major contribution to the very basic question of how one separates the influences of simple Frenkel defects from those of complex defect configurations as is normally obtained in heavy particle or neutron irradiated materials. Author

N70-41545# Bettis Atomic Power Lab., Pittsburgh, Pa.
FURTHER STUDIES DEFINING THE AQUEOUS CORROSION PERFORMANCE OF A ZIRCONIUM-NIOBIUM-COPPER ALLOY
Stanley Kass Apr. 1970 14 p ref
(Contract AT(11-1)-GEN-14)
(WAPD-TM-754) Avail: NTIS

Additional experiments were performed to further explore the influence of heat treatment upon the corrosion performance of a Zr + 2.5% Nb + 0.5% Cu alloy. Heat treating in the alpha-plus-beta region followed by rapid cooling to room temperature and a subsequent anneal at 1000 F yielded a material with high corrosion resistance in 600 and 680 F water. The corrosion resistance increased with increasing cooling rate from the alpha + beta region prior to the alpha anneal. On the other hand, hydrogen pickup was found to increase with increasing cooling rate. The hydrogen absorption rate of the material heat treated for high corrosion resistance was found to be particularly poor in 600 F water. Author (NSA)

N70-41547# Oak Ridge National Lab., Tenn.
COMPATIBILITY OF FUSED SODIUM FLUOROBORATES AND BF3 GAS WITH HASTELLOY N ALLOYS
J. W. Koger and A. P. Litman Jun. 1970 20 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2978) Avail: NTIS

Corrosion by NaBF4-NaF mixtures (4 to 8 mole % NaF) low in oxygen and water was studied with 6800-hr static tests at 605 C in standard Hastelloy N capsules with titanium-modified Hastelloy N specimens. Boron trifluoride gas was added to overpressures up to 400 psig. Specimens in the molten salts and at the interface showed both weight gains and losses. The gains decreased with increasing NaBF4 content, and losses up to 0.03 mg/cm2 were observed for specimens in 4 mole % NaF. Weight changes of specimens in vapor were very small and independent of overpressure. The main reaction was the oxidation of chromium in the alloy by iron fluoride in the salt to form Na3CrF6 and deposit iron on both specimens and capsule. Metallographic examination showed only minor attack and no difference in the two Hastelloy N alloys. The rate of chromium depletion at 605 C was consistent with the rate of solid-state diffusion of chromium to the alloy surface. Author (NSA)

N70-41564# Israel Program for Scientific Translations, Ltd., Jerusalem.
INVESTIGATION OF DIFFUSION OF SULFUR IN SOME REFRACTORY METALS [ISSLEDOVANIE DIFFUZII SERY V NEKOTORYKH TUGOPLAVIKH METALLAKH]
M. M. Pavlyuchenko et al 1970 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk BSSR (Minsk), v. 8, no. 3, 1964 p 157–160 Supported by NSF and NBS
(TT-70-57010) Avail: NTIS

The report concerns the diffusion of sulfur into cobalt, chromium, molybdenum, and tungsten. USGRDR

N70-41567# National Science Foundation, Washington, D.C.
DIFFUSION OF IRON IN NICKEL [DIFFUZIYA ZHELEZA V NILEL]

M. B. Neiman et al 1970 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow, v. 91, no. 2, 1953 p 265–267
(TT-70-57036) Avail: NTIS

The paper studies the diffusion of iron in nickel following the method suggested by S. N. Kryukov and A. A. Zhukhovitskii, which is a new variant of the method of labelled atoms used for determining the diffusion coefficients of solids. USGRDR

N70-41568# National Science Foundation, Washington, D.C.
RELATION BETWEEN THE COEFFICIENT OF SELF-DIFFUSION OF ZINC AND GRANULARITY [ZAVISIMOST KOEFFITSIENTA SAMODIFFUZI TESINKA OT ZERNISTOSTI]
I. A. Naskidashvili et al 1970 14 p refs Transl. into ENGLISH from Soobshcheniya Akad. Nauk Gruzin. SSR (Tiflis), v. 18, no. 6, 1957 p 671–678
(TT-70-57038) Avail: NTIS

The metallic zinc, the increase in granularity causes a monotonous increase in the coefficient of self-diffusion. The lesser the number of grains in 1 sq mm of the microsection of the sample, the greater is the effect of granularity on the coefficient of self-diffusion of zinc. The increase in the coefficient of self-diffusion with the increase in the number of grains is caused by the decrease in activation energy. In the temperature range of 540K to 640K, the temperature dependence of the coefficient of self-diffusion is linear irrespective of the number of grains. Author (USGRDR)

N70-41570# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME DATA ON COEFFICIENTS OF HETERODIFFUSION IN Cu-Ni, Fe-Ni, Fe-Cr ALLOYS WITH DISTORTED AND NONDISTORTED CRYSTAL LATTICES [NEKOTORYE DANNYE O KOEFFITSIENTAKH GETERODIFFUZII V SPLAVAKH CU-NI, FE-NI, FE-CR S ISKAZHENNOI I NEISKAZHENNOI KRYSTALICHESKOI RESHETKOI]
E. F. Chaikovskii 1970 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 112, no. 4, 1957 p 716–719
Supported by NSF and NBS
(TT-70-57013) Avail: NTIS

The coefficients of heterodiffusion were determined roentgenographically. USGRDR

N70-41618# California Univ., Berkeley.
INTERFACE EFFECTS IN MASS TRANSFER CONTROLLED CORROSION REACTIONS
I. Cornet and D. W. Fuerstenau 1 Jul. 1970 34 p refs
(Contract N00014-67-A-0114-0015)
(AD-709468; MSE-70-1) Avail: NTIS CSCL 11/6

The purpose of the investigation was to delineate the role played by surface active agents in mass transfer-controlled corrosion reactions in a saline environment. Major effort was directed toward dynamic systems where the metal surface moves relative to the saline solution. The galvanostatic polarization technique has been used to detect the specific role of concentration and chain length of amine surfactants in the corrosion reaction at the metal-aqueous solution interface, specifically at the Monel-saline solution interface. The chain length effect, i.e. increased corrosion inhibition with increased chain length, is considered to be related to hemi-micelle formation or two-dimensional condensation of adsorbed surfactant. Author (TAB)

N70-41633# Iowa Univ., Iowa City. Dept. of Mechanical Engineering.
FATIGUE BEHAVIOR OF MOLYBDENUM
R. I. Stephens, R. G. Dubensky, L. L. Frauen, and R. L. Wrenn May 1970 27 p refs
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-709580; THEMIS-UI-21) Avail: NTIS CSCL 11/6

The objective of the research was to further elucidate the fatigue behavior of commercially pure arc-cast polycrystalline molybdenum; in particular, to investigate the possible relationship between the French damage line and cyclic dependent yield behavior, and to determine coaxing phenomena as a function of grain size. Although the French damage line and the cyclic yield point removal line appear macroscopically similar, the mechanisms proposed for these two phenomena are quite different. The removal of the upper yield point under cyclic stress conditions is explained in terms of localized cumulative multiplication of mobile dislocations, whereas the French damage line is explained in terms of the initiation and propagation of microcracks. Molybdenum, vacuum annealed at 2150 F, 2600 F and 3000 F with resulting ASTM grain sizes of 7-8, 4-5 and 2-3 respectively, was subjected to various coaxing patterns. Using a cycle ratio summation as a criteria, no definite coaxing response pattern occurred for all three molybdenum grain sizes. Cycle ratio summations n/N ranged from .004 to 808. Thus, Molybdenum did respond to coaxing under certain applied stress and cycle increment conditions. Author (TAB)

N70-41670# National Science Foundation, Washington, D.C.
EFFECT OF CONTAMINANTS ON THE RATE OF SELF-DIFFUSION [O VLIYANII PRIMESEI NA SKOROST SAMODIFFUZII]
M. E. Yanitskaya et al 1970 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 112, no. 4, 1957 p 720–723
(TT-70-57012) Avail: NTIS

The concept explaining the effect of contaminants on the rate of volume diffusion and self-diffusion by their action on the thermodynamic properties of the alloy (for example, on the heat of sublimation) is not valid for explaining the action by low concentrations. Actually, contaminants considerably increase the coefficient of self-diffusion of the solvent at very small concentrations, whereas heat of vaporization of the solvent and its other partial thermodynamical properties practically do not change. In order to illustrate this fact, we determined parameters of self-diffusion and thermodynamical characteristics of solvent in two systems out of which one (Ag-Cu) has positive and the other (Ag-Sn) negative deviations from Roult's law. Self-diffusion was studied by the method of thin layers. The obtained values of the parameters of self-diffusion are given. USGRDR

N70-41671# National Science Foundation, Washington, D.C.
DEPENDENCE OF THE COEFFICIENT OF DIFFUSION ON THE CONCENTRATION OF THE DIFFUSING METAL [ZAVISIMOST KOEFFITSIENTA DIFFUZII OT KONTSENTRATSII DIFFUNDIRUYUSHCHEGO METALLA]
V. S. Bugakov et al 1970 16 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Leningrad), v. 7, no. 15, 1937 p 1577–1583
(TT-70-57032) Avail: NTIS

The diffusion of Zn and Cd in silver was studied at different concentrations of the diffusing metal. It was shown that during diffusion of Cd in silver, the coefficient of diffusion remains constant in the concentration range of 0 to 5%. At higher concentrations, the value of D increases considerably and depends on the concentration. During diffusion of Zn in silver in the range of 0 to 10%, the coefficient of diffusion changes very minutely and is practically constant. At 15% zinc, the value of D increases slightly. Different ranges of concentrations, below which the coefficient of diffusion does not change, are explained by different atomic radii of diffusing metals. Author (USGRDR)

N70-41687# McElroy (Ralph) Co., Austin, Tex.
THERMAL CYCLING BEHAVIOR OF URANIUM-RICH ALLOYS
G. Fizzotti et al [1970] 14 p refs Transl. into ENGLISH from

Italian report RT/MET-(69)1 Sponsored by AEC Prepared for Los Alamos Sci. Lab., N.Mex.
(LA-4291-TR; RT/MET-(69)1) Avail: NTIS

Investigations on thermal cycling behavior of binary and ternary uranium-rich alloys containing 0.5 to 3 wt % molybdenum, niobium, and zirconium are described. Additions of molybdenum and niobium to uranium were more effective in reducing surface wrinkling than additional zirconium. Surface wrinkling was influenced by the size and shape of the alpha grains produced in the alloys by different thermal treatments. Author (NSA)

N70-41688# Indian National Scientific Documentation Centre, New Delhi.
DIFFUSION AND BONDING IN METAL ALLOYS [DIFFUZIYA I SVYAZV METALLICHESKIKH SPLAVAKH]
I. Ya. Dekhtyar 1970 21 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Moscow), v. 20, no. 8, 1950 p 1015–1024 Prepared for NSF and NBS
(TT-70-57021) Avail: NTIS

Different types of diffusion mechanisms were examined. The most probable mechanism in substitutional alloys is diffusion through vacancies. Based on the experimentally established relationship between the activation energy E sub a and bond energy E sub b, viz., E sub a = k E sub b, of self-diffusion, the applicability of a similar relationship to the diffusion in the substitutional alloys has been assumed. It is possible to obtain the value of the coefficient k from the results of investigations on the effect of small additions (impurities) on the diffusion process in these alloys; the value is approximately equal to that of self-diffusion in metals with a similar coordination number. This fact points to a similarity of diffusion mechanisms in substitutional alloys and self-diffusion in metals. The coefficient k may serve as an index of the nature of the bond in alloys. Author (USGRDR)

N70-41689# Indian National Scientific Documentation Centre, New Delhi.
APPLICATIONS OF ARTIFICIAL RADIOACTIVE INDICATORS FOR STUDYING DIFFUSION AND SELF-DIFFUSION IN ALLOYS [PRIMENENIE ISKUSSTVENNO-RADIOAKTIVNYKH INDIKATOROV DLYA IZUCHENIYA PROTSESSOV DIFFUZII I SAMODIFFUZII V SPLAVAKH]
P. L. Gruzin 1970 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSR (Moscow), v. 86, no. 2, 1952 p 289–292 Prepared for NSF and NBS
(TT-70-57022) Avail: NTIS

A method was described for measuring the diffusion coefficients in solid bodies using artificial radioactive isotopes. By using the artificial radioactive isotope Co-60, the temperature dependence of self-diffusion coefficient of cobalt was determined, which is expressed by the equation D = 0.2e (62,000/RT sq cm/sec). The ratios Q/E and Q/T sub f were determined for cobalt and were equal to 0.73 and 36, respectively. Author (USGRDR)

N70-41720# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
ENVIRONMENTAL CORROSION-FATIGUE BEHAVIOR OF ALUMINUM ALLOYS
D. N. Williams Jun. 1970 19 p refs
(Contract F33615-69-C-1343)
(AD-709399; DMIC-M-249) Avail: NTIS CSCL 11/6

The effects of environment on fatigue behavior are quite intimately related to such test variables as stress intensity, cyclic frequency, and temperature. The effect of these variables has been shown to be quite complex. However, a consistent pattern of behavior is beginning to emerge which, it is hoped, will lead to a considerably changed understanding of the corrosion-fatigue process. It is considered probable that an increased understanding of the corrosion-fatigue process will also contribute measureably to an improved understanding of general fatigue processes. Material variables such as composition, directionality of properties, and microstructure, have important effects on corrosion-fatigue behavior of aluminum alloys. However, it appears that these variables, at least in gaseous environments, may be important largely because of their effects on the mechanical behavior of aluminum alloys. On the other hand, studies in seawater suggest that these variables become increasingly important as the corrosive nature of the environment increases. This memorandum discusses in detail the effects of both test variables and material variables on corrosion fatigue. In addition, current theories of corrosion-fatigue mechanisms are outlined, and several methods of preventing corrosion fatigue are suggested. Author (TAB)

N70-41735# TRW Equipment Labs., Cleveland, Ohio. Materials Technology Dept.
EVALUATION OF HYDROGEN EMBRITTLEMENT MECHANISMS
C. F. Barth and E. A. Steigerwald 1 Jul. 1970 24 p refs
(Contract N00014-69-C-0286)
(AD-709164; ER-7477) Avail: NTIS CSCL 11/6

The incubation time which precedes the initiation of slow crack growth in the delayed failure of high-strength steel containing hydrogen was reversible with respect to the applied stress. The kinetics of the reversibility process indicated that it was controlled by the diffusion of hydrogen and had an activation energy of approximately 9000 cal/mole. Reversible hydrogen embrittlement studies were also conducted at liquid nitrogen temperatures where diffusional processes should not occur. The previously reported low temperature embrittlement behavior was confirmed indicating a basic interaction between hydrogen and the lattice. The experimental results could be satisfactorily explained by the lattice embrittlement theory proposed by Troiano. Author (TAB)

N70-41737# Israel Program for Scientific Translations, Ltd., Jerusalem.
PHYSICAL METALLURGY AND HEAT TREATMENT [METALLOVEDENIE I TERMICHESKAYA OBRABOTKA]
N. V. Ageev, ed. et al 1970 199 p refs Transl. into ENGLISH of the book "Itogi Nauki i Tekhniki: Metallurgiya" Moscow, 1966 Sponsored by Dept. of Com. and NSF
(TT-69-55040) Copyright. Avail: NTIS

Contents: Fiber materials (strength and structure); Strengthening of materials by dispersed particles (materials of the SAP type); Metals and alloys for the construction of industrial chemical equipment; High-temperature thermomechanical treatment (HT ausforming) of steel. USGRDR

N70-41759# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
EFFECT OF HYDROSTATIC ROLLING CONDITIONS ON THE MALLEABILITY OF BRITTLE MATERIALS
Dennis R. Floyd 12 May 1970 29 p refs
(Contract AT(29-1)-1106)
(RFP-1383) Avail: NTIS

The relation between stress state and malleability for sheet rolling brittle materials is examined. Improvements in the malleability of beryllium metal is achieved by altering the rolling conditions, but the effect of these conditions on stress state is unknown. A detailed analysis of the rolling process results in the following relationship between stress state, R, and the key rolling variables of friction coefficient (mu), contact length (l), and thickness (t): R = 1-(z/e sup z − 1), where z = mu l/t. This theory, confirmed by tests with mild steel, shows that all three variables contribute to the same degree in changing stress state. Thus, doubling the friction coefficient or contact length has the same effect on stress state as halving the initial thickness. The curve resulting from the

above relationship has a steep slope for z values under 2, where most rolling is done. Thus a large increase in stress state can be achieved by relatively minor changes in rolling conditions. Author (NSA)

N70-41787 Detroit Univ., Mich.
ENHANCED PLASTICITY: AN INVESTIGATION OF ALUMINUM ZINC, COPPER, MAGNESIUM ALLOYS FOR METAL FORMING PROCESS IMPROVEMENT
Louis T. Feng (Ph.D. Thesis) 1969 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-18347

Three ranges of aluminum-zinc alloys, (1) 70 wt.%Al, 30 wt.%Zn, (2) 22 wt.%Al, 78 wt.%Zn, and (3) 12 wt.%Al, 88 wt.%Zn, with copper, magnesium, and manganese additions up to 3.0, 1.0 and 0.2 wt%, respectively, were investigated. A thermal decomposition method of obtaining a fine micro-structure to achieve enhanced plasticity is presented. The effects of alloying element additions, solidification rates (graphite mold versus sand versus continuous casting), annealing time (up to 72 hours), aging time and temperatures (75 F, 20 hours and 200 F, 2 hours), and mechanical working were determined. Correlations between these effects were made with reference to current metal deformation theories aided by electron microscopic studies, X-ray microprobe and computer analysis. A closed-die forming process was conceived and demonstrated, using alloys and heat treatment cycles developed for this experiment. Dissert. Abstr.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N70-40436# National Bureau of Standards, Washington, D.C.
ARPA-NBS PROGRAM OF RESEARCH ON HIGH TEMPERATURE MATERIALS AND LASER MATERIALS Technical Note, 1 Jul. – 31 Dec. 1970
A. D. Franklin and H. S. Bennett Jun. 1970 79 p refs
(AD-708582; NBS-TN-531) Avail: NTIS CSCL 11/2

Brief reviews are given of work performed on a number of projects concerned with high temperature materials and with laser materials. Under the High Temperature Materials heading, topics include diffusion of oxygen in oxides, growth of Al_2O_3 crystals by chemical vapor deposition, the electronic structure of transition metal borides and related compounds, the optical constants of titanium, high temperature creep in copper, and the mechanism of volatilization of polymers and long-chain compounds. Work on laser materials includes measurement of bulk optical and elastic properties of laser materials, a study of the orange degradation of ruby, measurements of sub-crystal misalignment in ruby, damage in glass induced by high-energy laser pulses, chemical analyses for ruby and Nd-doped laser glasses, and preliminary studies on detection of submicroscopic inhomogeneities in glass. Author (TAB)

N70-40456# Army Electronics Command, Fort Monmouth, N.J. Electronic Components Lab.
COMPOSITE POLYMER FILMS FOR USE AS CAPACITOR DIELECTRICS
Wayne R. Wenger Jun. 1970 21 p refs
(AD-708551; ECOM-3290) Avail: NTIS CSCL 11/9

Methods of preparing polycarbonate and polysulfone films loaded with $BaTiO_3$ and/or organic compounds have been modified and the dielectric properties of the films have been determined. The dielectric constants range from 3 to 184, and the energy storage capacity extends from 0.02 to 11.2 j/cu in. By the proper choice of percent $BaTiO_3$ and of the organic component, films with a K of 134 and E of 10.2 j/cu in as the optimum can be cast. Author (TAB)

N70-40492# National Research Council of Canada, Ottawa (Ontario). National Aeronautical Establishment.
THE INFLUENCE OF SODIUM SULPHATE AND SODIUM CHLORIDE ON THE OXIDATION RESISTANCE OF A Cr-Ti-Si COATING ON ALLOY B66
E. P. Whelan and J. M. Trenouth Dec. 1969 35 p refs
(MS-127; NRC-11328) Avail: NTIS

Coated specimens were contaminated by Na_2SO_4 salt concentrations of approximately 1 mg/sq cm, and oxidized at 1100, 1200, and 1300 C. Oxidized contaminated specimens exhibited initial mass gains considerably greater than those of identical uncontaminated specimens. The contaminated surface became brown, glassy, and bubbly within 10 minutes of being exposed to the oxidizing environment. Microstructures of oxidized contaminated specimens indicated that the protective silicide coating zones oxidized at a more rapid rate than did those of uncontaminated specimens, and that an array of particles, possibly titaniumoxides or nitrides, formed in the diffusion zone in less than 100 minutes at 1300 C. Electron probe microanalysis did not detect any sodium or sulphur in the oxide or substrate after 300 minutes exposure at 1300 C. Oxidation prior to Na_2SO_4 contamination did not increase the subsequent corrosion resistance of the coatings. A preliminary investigation indicated that NaCl also influenced the oxidation resistance of coated specimens in a deleterious manner. Author

N70-40507# North Carolina State Univ., Raleigh. Dept. of Engineering Research.
FLOW AND FRACTURE IN SPINEL STRUCTURED CERAMICS Final Report, Apr. 1964 – Aug. 1968
Hayne Palmour, III Jan. 1970 43 p refs
(Contract DA-31-124-ARO(D)-207)
(AD-708915; AROD-4932.8-MC) Avail: NTIS CSCL 11/4

The report describes research concerned with sapphire whisker reinforced spinel. The report includes sections which describe the scope of the work, scientific personnel, publications and technical reports generated under the contract, or as a consequence of it, and a technical summary of the work accomplished. Author (TAB)

N70-40517 National Lending Library for Science and Technology, Boston Spa (England).
THE MECHANICAL PROPERTIES OF SINGLE FIBRES
B. Duncker et al 29 May 1970 32 p Transl. into ENGLISH from Svensk Papperstid. (Stockholm), v. 71, no. 5, 1968 p 165–177
(NLL-M-9177-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

A survey of literature covering the mechanical properties of single fibers was conducted, and the methods for determination of the strength and stiffness of fibers are discussed. The influence of the morphology of the fiber and pulp-making variables on these properties is reviewed. The somewhat divergent opinions on the relationship between the properties of the fibers and the properties of the sheets are discussed. Author

N70-40527# Aerospace Corp., El Segundo, Calif. Technical Development Program Office.
SPACE ENVIRONMENTAL TESTING OF ADVANCED COMPOSITE MATERIALS
Henry S. Judeikis, George Epstein, Eugene W. Borson, and Gary

W. Stupian 1 Apr. 1970 45 p refs
(Contract F04701-69-C-0066)
(AD-708472; TR-0066(5360-01)-2; SAMSO-TR-70-218) Avail: NTIS CSCL 11/4

The document outlines the properties of advanced composites that are of primary interest for utilization of these materials in the space environment. Detailed consideration is given to laboratory simulation of the space environment and materials testing for the desired properties in the simulated environment. Author (TAB)

N70-40653# Iowa State Univ. of Science and Technology, Ames.
A LITERATURE SURVEY ON PHYSICOCHEMICAL PROPERTIES OF GLASS SURFACES AND THEIR INTERACTION WITH VAPORS
Rodney J. Huang, Richard D. Johnson, Turgut Demirel, and Thomas D. McGee Feb. 1970 115 p refs
(Contract F33615-68-C-1034)
(AD-708709; ERI-68500) Avail: NTIS CSCL 7/4

The literature from 1949 through mid-summer 1969 has been searched and screened. This paper contains two parts: (1) a discussion of properties of glasses and adsorbates, and theories concerning sorption, (2) a list of abstracted literature. An author index and a list of the literature covered are also included. One hundred and thirty periodicals have been searched; the abstracts included in this report are from 334 authors and 233 articles. Author (TAB)

N70-40664 National Lending Library for Science and Technology, Boston Spa (England).
EMISSION PROPERTIES OF REFRACTORIES
P. Robijn et al May 1969 21 p refs Transl. into ENGLISH from Verres Refract. (France), no. 7, 1963 p 3–10 Presented at the 14th Journee de Conf. Tech., Brussels, 6 Nov. 1962
(NLL-LB-G-2859-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The emission properties of the refractories used for the walls of glass-making furnaces are studied to provide better solutions to the problems of heat exchange. The monochromatic emission of various materials were measured by a Perkin-Elmer double-beam IR spectrophotometer. The results for vitreous silica, aluminium oxides, magnesium oxides, and zirconium compounds are discussed. The factors that affect emissivity are examined, and include temperature, surface conditions, the atmosphere surrounding the refractory surface, and impurities. F.O.S.

N70-40734 National Lending Library for Science and Technology, Boston Spa (England).
EMISSIVITIES OF ALUMINOSILICATE REFRACTORIES AT HIGH TEMPERATURES
M. Michaud Jun. 1969 3 p Transl. into ENGLISH from Compt. Rend. (France), v. 228, 1949 p 1115–1116
(NLL-LB-G-2867-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The monochromatic and total emissivities of refractory oxides were determined in the temperature range 1000 to 1600 C. The determinations were made by rotating cylindrical samples in a flat oxygen town-gas flame. Temperatures were measured using an optical pyrometer for true and brightness temperature, and an irised thermopile for radiation temperature. Results show emissive variations are caused by iron oxide traces and that chemical composition has little effect on aluminosilicate emissivity. E.H.W.

N70-40791# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF HYDROPHOBIZATION OF THE SURFACE OF GLASS FIBERS ON THEIR PROPERTIES
M. S. Aslanova 30 Mar. 1970 12 p refs Transl. into ENGLISH from the book 'Khimicheskaya Obrabotka Poverkhnosti Steklyannogo Volokna' Moscow, Izd-Vo Khimiya, 1966 p 10-14
(AD-708445; FTD-MT-24-52-70) Avail: NTIS CSCL 11/5

Due to the hydrophilic nature of glass fibers, upon the adsorption of water there is a considerable reduction of their surface energy. Addition to the water of surface-active substances (from 0.5 to 1%), possessing high polarity, causes an additional drop in strength during both short-term and prolonged loading. It was revealed that after hydrophobization of the surface of glass fibers from nonalkali glass by organosilicon compounds there is no change of strength in time. Thus, it has been established that hydrophobization of the surface of glass fibers by organic organosilicon substances improves their mechanical, electrical and adhesional properties. Author (TAB)

N70-40799# Aerospace Corp., El Segundo, Calif. Lab. Operations.
PULSE PROPAGATION IN A LAMINATED MEDIUM, REPORT FOR MARCH–DECEMBER 1969
John P. Jones 15 Jun. 1970 29 p refs
(Contract F04701-69-C-0066)
(AD-708464; TR-0066(5240-30)-7; SAMSO-TR-70-217) Avail: NTIS CSCL 20/11

Because of their strength and thermal properties, composite materials are becoming increasingly useful in many aerospace applications. One of the more interesting applications of composites is the use of their dispersive properties to reduce the damaging effects of stress pulses as they propagate through layers of composites. The work investigates one-dimensional propagation of a stress wave in a composite composed of alternating layers of two materials. The layers are inclined at an arbitrary angle to the direction of propagation, and an effective modulus theory is used to describe the physical properties of the medium. Author (TAB)

N70-40822# Massachusetts Univ., Amherst. Polymer Research Inst.
DIELECTRIC AND RHEO-OPTICAL PROPERTIES OF SOME BROMINATED POLYETHYLENES
Paul J. Phillips and Richard S. Stein Jun. 1970 22 p refs Sponsored in part by Am. Chem. Soc.
(Contract Nonr-3357(01))
(AD-708744; ONR-TR-124) Avail: NTIS CSCL 11/9

Dielectric and rheo-optical investigations have been carried out on various brominated polyethylene samples. The crystallinities are reduced somewhat, from 55% to 42%, and the melting point is depressed by 4C. Annealing causes no increase in crystallinity, but perfects the interior of the spherulites. Variations in the mechanical and dielectric dispersions on annealing are interpreted on the bases of the gamma relaxation occurring due to amorphous intracrystalline material and the bromine atoms being situated on folds and/or scillia. Author (TAB)

N70-40940# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
A CENTER OF EXCELLENCE IN CERAMIC AND COMPOSITE MATERIALS Summary Progress Report, 1 Sep. 1968–31 Aug. 1969
Thomas D. McGee 31 Aug. 1969 130 p refs
(Contract F33615-68-C-1034; Proj. THEMIS)
(AD-708705; ERI-551; PR-8) Avail: NTIS CSCL 11/2

Reports are presented on the following topics: Initial creep and recovery experiments on rutile and MgO; Chromium diffused into the surface of Al2O3; Water adsorption on Fiberglas E; Neutron activation analysis of NaCl, MgO, CaF2, and Al2O3; An arc transfer method has successfully produced single crystals of NiO and CoO; The electronic conductivity of Gd-doped BaTiO3 has been successfully compensated with additions of Cu; Coulombic

titrations have been successfully made using an electrical potential to control the oxygen pressure in a solid electrolyte; A solid galvanic cell oxygen pressure gage has been designed and tested; A review of the conductivity domains of various solid electrolytes; A general theoretical treatment of the conditions necessary to produce a pure Rayleigh wave; High strength surface waves have been produced in an LiNbO3 crystal. TAB

N70-40976# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

PROPERTIES OF CERAMIC MATERIALS Progress Report, 1 Mar. –31 May 1970

Thomas D. McGee May 1970 67 p refs

(Contract F33615-68-C-1034; Proj. Themis)

(AD-708712; ERI-76500; PR-11) Avail: NTIS CSCL 11/2

Cermaic materials research progress including reversible emf measurements for M + M prime F = MF + M prime, where M = Ni, Mn, Co, Fe, and Y are reported as well as weight loss measurements at 10 to the minus 40th power atmospheres 02 at 1300 C, the production of poor thermal shock resistance in MgO controlled sintering of dense high purity aluminum oxide, stoichiometric rutile creep recovery at zero stress due to migration and coalescence of dislocation walls during the stress assisted recovery period, and surface wave analysis in piezoelectric crystals. Initial phase analysis, a surface area independent plot of energy versus thickness, and isoteric entropies of fiberglass water sorption are also mentioned. J.M.

N70-40997*# Bellcomm, Inc., Washington, D.C.

A REVIEW OF THERMAL CONTROL COATING DEGRADATION BY THE SERVICE MODULE REACTION CONTROL SYSTEM ROCKET EXHAUST AND ESTIMATED EFFECTS ON SKYLAB

G. M. Yanizeski 21 Sep. 1970 38 p refs

(Contract NASw-417)

(NASA-CR-113814; TM-70-1022-12) Avail: NTIS CSCL 11C

Available data, especially from related smaller engine tests, is evaluated in light of the Skylab space environment, firing schedule, and geometry. The Skylab surface area most susceptible to degradation by rocket exhaust is the SM RCS sun side door (at Quad A). This door can receive concentrated exhaust plume impingement, and an end-of-mission solar absorptance of 0.5 can be expected even without any post-docking firing events. According to calculations, this RCS door requires a solar absorptance below 0.6 to maintain propellant tank temperatures. Since the present Skylab SM RCS firing schedule does not include long continuous firings (except possibly after separation) or a long series of short pulse type firings, the SM RCS likely will not degrade the RCS door area much beyond the 0.5 absorptance value. Author

N70-41005# National Bureau of Standards, Washington, D.C. Inorganic Materials Div.

RESEARCH MATERIALS DEVELOPED UNDER THE NBS INORGANIC MATERIALS PROGRAM

F. E. Brinckman and J. B. Wachtman, Jr., eds. Sep. 1970 73 p refs

(NBS-Spec-Publ-333) Avail: SOD $0.70

A brief summary of the nature, method of preparation, and properties determined for each material is given. Author

N70-41027*# Case Western Reserve Univ., Cleveland, Ohio. Div. of Metallurgy and Materials Science.

MULTICOMPONENT DIFFUSION IN GLASSES: THEORY AND APPLICATION TO TEKTITES

Arun Kumar Varshneya (Ph.D. Thesis) Sep. 1970 205 p refs

(Grant NGR-36-003-001)

(NASA-CR-113821) Avail: NTIS CSCL 11B

Unidirectional, semi-infinite diffusion couples were made at temperatures between 650 and 800 C, along four directions on the K2O-SrO-SiO2 composition space near the 20,20,60 wt. % composition. It was found that Onsager's extension of Fick's law provides an adequate description to the kinetics of multicomponent diffusion process through the use of an interdiffisuon coefficients matrix. The relation between the interdiffusion coefficients and the self-diffusion coefficient in this system was quantitatively examined using the atomic mobility model. The concept of an effective binary diffusion coefficient (EBDC) in a multicomponent system was then applied to the problem of origin of tektites. Sections of a Thailand tektite were analyzed under an electron microprobe for composition fluctuations. A comparison is made with similar data from laboratory-synthesized tektite glasses and other natural glasses including lunar specimens from the Apollo 12 site. The EBDC of iron and silicon were also measured. Limits for minimum thermal history of 2172 Thailand tektite are suggested. Author

N70-41109# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.

EXPLORATORY DEVELOPMENT OF FRACTURE MECHANICS OF COMPOSITE SYSTEMS Annual Progress Report, May 1969 – Apr. 1970

G. C. Sih, P. D. Hilton, and R. P. Wei Jun. 1970 69 p refs

(Contract F33615-69-C-1417)

(AD-709214; AFML-TR-70-112) Avail: NTIS CSCL 11/4

The objective of the research program is to provide an improved understanding of the failure of composites from the fracture mechanics point of view. Such an approach assumes that the composite possesses built-in imperfections such as voids or cracks developed during the fabrication process or under operating stresses. Two composite systems are studied: the first is a fiber-reinforced composite and the second a laminated compoite. Theoretical analyses made in terms of continuum mechanics for stress distributions are carried out to establish the relationships among the pertinent parameters. Such a study should reveal the necessary insight for developing failure criteria of composites. Some preliminary experimental results on fracture toughness and crack growth rates of unidirectionally fiber reinforced composites are also given. Author (TAB)

N70-41168*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE ORIENTATION OF CRYSTALLITES IN MOLDED GRAPHITES

David R. Schryer (M.A. Thesis—Coll. of William and Mary, Va.) 1970 76 p refs

(NASA-TM-X-66348) Avail: NTIS CSCL 11B

An extensive investigation of the orientation of crystallites in molded, artificial graphites was performed. It was found that the crystallites in molded graphites are usually, but not always, distributed symmetrically about some axis. The symmetry axis has been found to differ frequently from the molding axis, contrary to what has generally been assumed. Furthermore, the direction of the symmetry axis and the degree of orientation have been found to vary somewhat within a given graphite block. An equation has been found to be suitable for describing the distribution of crystallites about the symmetry axis. The equation involves two unspecified parameters. Specification of the direction of the symmetry axis involves two additional parameters. A technique for evaluating these parameters from experimental data obtained by the Bacon method is presented. Also presented are recommendations for future research. Author

N70-41169*# Kentucky Univ., Lexington. Office of Research and Engineering Services.

ROLE OF ANIONS IN MECHANICAL FAILURE Annual Report

Martin H. Leipold and Cawas M. Kapadia 15 Jun. 1970 40 p refs
(Grant NGL-18-001-42)
(NASA-CR-113919; UKY-25-70-MET-12; AR-1) Avail: NTIS CSCL 11B

The results of the first half of a program directed toward the evaluation of the influence of anion impurities on the behavior of a polycrystalline ceramic (MgO), are presented. The responses being evaluated are fabricability, grain growth, microhardness, and grain boundary diffusion. Information on the techniques being used is included. Author

N70-41189# Aerospace Corp., El Segundo, Calif. Lab. Operations.
MICRO-CREEP OF A POLYMERIC ADHESIVE, OCTOBER 1968–AUGUST 1969
Ronald C. Rossi, Harold Smallen, and Jesse Steinman 1 Jul. 1970 31 p refs
(Contract F04701-70-C-0059)
(AD-709201; TR-0059(6250-10)-2; SAMSO-TR-70-243) Avail: NTIS CSCL 11/1

The micro-creep of the commercial polymeric adhesive Epikote 817 was measured at 30C under a torsional shear load over a 6-month period. The design and assembly technique minimized strains in the testing fixture and provided a magnification of the creep of the adhesive. Creep was measured with an automatic autocollimator. The total creep displacement in the 6-month period was 12.2 x 10 to the -6th in. The creep rate for this adhesive under an 11.6-psi shear stress was 2.55 x 10 to the -9th in./in./month. Author (TAB)

N70-41267# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DIELECTRIC PROPERTIES OF POLYMER MATERIALS DURING PULSED GAMMA-NEUTRON IRRADIATION
V. V. Zubov et al 26 Mar. 1970 6 p refs Transl. into ENGLISH from Vysokomol. Soedin., Ser. B (USSR), v. 11, no. 5, 1969 p 324–325
(AD-709699; FTD-HT-23-191-70) Avail: NTIS CSCL 11/9

The dielectric properties of polyethylene, poly(tetrafluoroethylene) (oriented and nonoriented), polystyrene and poly (Me methacrylate) were measured in a field of pulsed gamma-neutron irradiation. The measurements indicated that the dielectric loss and dielectric permeability were proportional to irradiation intensity. A plot of specific conditions vs irradiation intensity confirmed that the dielectric properties of insulators measured during irradiation were dependent on their structure. TAB

N70-41358# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
CONCERNING ELECTRON EMISSION (KRAMER EFFECT) OF BERYLLIUM OXIDE [ZUR EXOELEKTRONEN-EMISSION (KRAMER-EFFEKT) VON BERYLLIUMOXID]
Georg Holzapfel (Ph.D. Thesis) 1968 78 p refs In GERMAN
Avail: NTIS

The electron emission characteristics of beryllium oxide at high temperatures are reported. The numerical measurements of a point by point evaluation of the spectrum obtained by thermal and optical stimulation are presented. The test equipment is described, and the results of the research are explained by graphs and tables. Transl. by P.N.F.

N70-41457*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LAMINATION RESIDUAL STRESSES IN CROSS-PLIED FIBER COMPOSITES
Christos C. Chamis [1970] 30 p refs To be presented at the 26th Ann. Conf. of the Soc. of Plastic Ind., Inc., Washington, D.C., 9-12 Feb. 1971
(NASA-TM-X-52881) Avail: NTIS CSCL 11D

Residual stresses arising from the lamination fabrication process are investigated using linear laminate theory. An equation to predict the residual stresses is given. The pertinent variables which influence residual stresses are identified. Several composite systems with various ply lay-up configurations are examined. Results are presented to illustrate the dependence of the residual stresses on the pertinent variables. The residual stresses are very sensitive to constituent material properties, ply stacking sequence and orientation, fiber content, and cure temperature. It is found that ply transverse and in-plane shear residual stresses can reach magnitudes comparable to corresponding ply strengths and cause transply cracks in the composites. Residual stresses can also cause interply delamination. Ways to prevent transply cracks and interply delamination are recommended. The effects of the residual stresses on the design of a composite compressor blade are illustrated. Author

N70-41458# Aerospace Corp., El Segundo, Calif. Lab. Operations.
STUDY OF ZIRCONIUM DIOXIDE WHITE PIGMENT FOR SPACE ENVIRONMENT, JULY 1967–SEPTEMBER 1969
H. K. Alan Kan, Robert J. Champetier, and Theodore G. Erler 31 Jul. 1970 51 p refs
(Contract F04701-70-C-0059)
(AD-709204; TR-0059(6250-20)-4; SAMSO-TR-70-257) Avail: NTIS CSCL 11/3

The properties of zirconium dioxide as a stable white pigment (low alpha/epsilon) for space application are investigated. First, the optical absorption of single crystals is studied, leading to the conclusion that a high degree of purity, except for hafnium, is essential for stable white pigment applications. A subsequent pigment preparation study and irradiation experiments with UV and 3-keV protons are described. The ZrO coatings initially have alpha < 0.11 and epsilon = 0.9. Overall radiation stability (UV and proton) is shown to be binder-dependent, with potassium silicate more stable than silicones. Potassium silicate coatings show Delta alpha = 0.06 after 2400 UV equivalent solar hours, and Delta alpha = 0.01 after irradiation with 3-keV H(+) and H2(+) to a fluence of 10 to the 16th particles/sq cm. Author (TAB)

N70-41509# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
EXPERIMENTS FOR PRODUCING SULFUR CONTAINING EPOXY RESINS [VERSUCHE ZUR HERSTELLUNG SCHWEFELHALTIGER EPOXIDHARZE]
Martin Bobzien (Ph.D. Thesis) 1968 84 p refs In GERMAN
Avail: NTIS

Anthracene and carbazole, as well as their mixtures with phenanthrene, were used to produce sulfer containing epoxy resins. Reaction of their condensates with disulfuric dichloride and subsequent treatment with caustic soda gave thiophenolates which reacted with epichlorhydrine to produce epoxy prepolymers. Anthracene and N-methyl carbazole substitutions by S2Cl2 produced also resin compounds. Oxidation of the thiol glycidyl compound of N-methyl carbazole to the corresponding sulfonyl derivatives gave resins of acceptable quality. Transl. by G.G.

N70-41583* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
UNFIRED-CERAMIC FLAME-RESISTANT INSULATION AND METHOD OF MAKING THE SAME Patent
Vaughn F. Seitzinger, inventor (to NASA) Issued 3 Jan. 1967 (Filed 18 Oct. 1963) 11 p Cl 161-115
(NASA-Case-XMF-01030; US-Patent-3,296,060; US-Patent-Appl-SN-317389) Avail: US Patent Office CSCL 11D

A highly reflective composite insulating composition for large launch vehicles and missiles is described. The ceramic material consists of a bonding agent with a low curing temperature such as colloidal silica, to which are added an opacifier type filler, preferably of potassium titanate, and a shrinkage reducing agent of asbestos or glass fiber. The coating is covered by a protective film, and the composition cures into a solid low density coating with a hard dense outward protective layer. N.E.N.

N70-41648# Naval Research Lab., Washington, D.C. Inorganic Chemistry Branch.
FABRICATION AND CHARACTERIZATION OF HOT PRESSED L2O3 Interim Report
Roy W. Rice 7 Jul. 1970 31 p refs
(AD-709556; NRL-7111) Avail: NTIS CSCL 11/2

Hot pressing of Al2O3 with and without LiF is described, and the resultant bodies are characterized. Addition of LiF significantly enhances densification, allowing dense bodies to be obtained at about 1100C, which is 200 to 300C lower than without additives. However, the additives result in exaggerated grain growth even during hot pressing. Though the fluoride content is reduced, both during hot pressing and subsequent annealing, some fluoride remains which could be detrimental to some properties of bodies made with LiF. Some of the problems and defects of pressing are emphasized as an aid to improving the process. Particular attention is given to the analysis of H2O, CO2, and S impurities (which are probably present as chemically bounded anions) and some of their known and possible effects on microstructure and behavior in materials made with and without additives. Author (TAB)

N70-41654# Army Materials and Mechanics Research Center, Watertown, Mass. Ceramics Div.
IMPACT ENERGY AND NOTCH SENSITIVITY OF CERAMIC MATERIALS
Samuel J. Acquaviva Jun. 1970 11 p refs
(AD-709606; AMMRC-TR-70-12) Avail: NTIS CSCL 11/2

The notched and unnotched impact energies of alumina, boron carbide, and silicon carbide were studied by the drop weight testing technique. The notch sensitivity ratio is defined as the ratio of unnotched to notched impact energy. It is shown that the notch sensitivy ratio varies from about 1.5 for a ductile material such as Ti-6Al-6V-2Sn to about 18.0 for the extremely brittle silicon carbide. The drop weight testing technique is better suited to determining impact energies of very brittle materials than the more conventional Charpy or Izod methods. Author (TAB)

N70-41702# Army Materials and Mechanics Research Center, Watertown, Mass. Ceramics Div.
DISLOCATION MOTION AND CRACK PROPAGATION EFFECTS IN THE IRON OXIDE MgO SYSTEM
Stuart L. Blank and Bette A. Blank Mar. 1970 21 p refs
(AD-709605; AMMRC-TR-70-5) Avail: NTIS CSCL 20/12

The method of indentation hardness to introduce and move fresh dislocations is applied in a concentration gradient. Using this technique, much information can be obtained with a few samples. The crack propagation and hardening effect of a divalent and trivalent iron concentration gradient were studied in magnesium oxide single crystals. The relative hardening versus iron concentration was found to be a nonlinear relation. An explanation is presented based on equilibrium constant relationships to account for this power variation. Samples containing Fe(+3) ions in solid solution were aged for various times to study the effects of magnesioferrite precipitation in the concenetration gradient. Once coherency was broken, the hardening of MgO due to the magnesioferrite precipitates was found to be a linear function of the iron concentration. A mechanism to explain the change in crack propagation direction upon reaching a critical trivalent iron concentration is also presented. Author (TAB)

N70-41773# Army Materials and Mechanics Research Center, Watertown, Mass.
DYNAMIC RESPONSE OF A CONSTRAINED FIBROUS SYSTEM SUBJECTED TO TRANSVERSE IMPACT. PART 2: A MECHANICAL MODEL
Francis deS. Lynch Jul. 1970 22 p
(AD-709607; AMMRC-TR-70-16) Avail: NTIS CSCL 11/5

A finite element mechanical model, capable of utilizing experimentally determined material properties, is presented for analyzing the deformation processes in a finite, constrained flexible filament subjected to transverse impact. The analysis is used to determine the effects of an elastic foundation transversely supporting a flexible filament subjected to transverse impact. Results of a finite element analysis of a transversely impacted isotropic membrane are presented to indicate the direction for future research. An appendix is attached which demonstrates the ability to include rate-dependent material properties in the analyses described above. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N70-40404 IIT Research Inst., Chicago, Ill.
SOME ASPECTS OF THE ZERO CROSSING PROBLEM
Edward Herman Lezak (Ph.D. Thesis) 1969 67 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-18798

A relation between the distribution function of the length of time between successive zeros of a wide-sense stationary stochastic process and the distribution function of the number of zeros in a given interval was determined. The zero crossing problem is treated in the more general context of a mixture stream of events. Under more restrictive conditions for a process, namely stationarity, normality, and a covariance function, a complete expression is given for the distribution function of the length of time between successive zeros of the process. Dissert. Abstr.

N70-40407# RAND Corp., Santa Monica, Calif.
PROPERTIES OF THE BIVARIATE NORMAL CUMULATIVE DISTRIBUTION
Dennis P. Tihansky (Harvard Univ.) Jun. 1970 11 p refs
(AD-708912; P-4400) Avail: NTIS CSCL 12/1

The key position of the normal distribution, both in probability and statistics, has led to extensive theory and applications of this density function. This paper investigates special properties of equi-distributional contours, defined as a functional relationship between lower limits on the range of integration for the upper bivariate normal cumulative distribution with fixed value. Although theory developed in the following sections pertains to the bivariate case, these results may be generalized to a larger number of variables. Author (TAB)

N70-40409 Utah Univ., Salt Lake City.
CROSS-PRODUCT CUBATURE ERROR ESTIMATES
Frank Gene Lether (Ph.D. Thesis) 1969 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-18673

The cubature error for a cross-product rule over a hyper-rectangle is discussed. Error representations are derived which express the cubature error in terms of certain partial derivatives of the integrand. For cyclic cubature rules, asymptotic error expansions are derived and Richardson extrapolation is used to obtain error estimates. Cubature error bounds for two and three dimensions are obtained by applying the Holder inequality to certain integral

representations for the cubature error. Numerical examples, which illustrate the theory, are included. The work extends known cubature error representations, for one and two dimensions, to n dimensions. For cyclic rules, a simple algorithm is developed to accurately estimate the cubature error. Dissert. Abstr.

N70-40426# Research Analysis Corp., McLean, Va.
UTILITY THEORY FOR DECISION MAKING Final Report
Peter C. Fishburn Jun. 1970 249 p refs
(Contracts DAHC19-69-C-0017; DA-44-188-ARO-1; N00014-67-C-0434)
(AD-708563; RAC-R-105) Avail: NTIS CSCL 12/2

The book presents a concise yet mathematically complete treatment of modern utility theories that covers nonprobabilistic preference theory, the von Neumann-Morgenstern expected-utility theory and its extensions, and the joint axiomatization of utility and subjective probability. Author (TAB)

N70-40430 Utah Univ., Salt Lake City.
OPTIMAL APPROXIMATION AND ERROR BOUNDS IN SPACES OF MULTIVARIATE FUNCTIONS
Lois Edna Mansfield (Ph.D. Thesis) 1969 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-18678

The function f is assumed to be a real-valued function of more than one variable having certain smoothness properties. A topology can be introduced which makes f a member of a Hilbert space. The optimal approximation and error bounds can be found if the representers of the functionals involved are known. The representers can be determined if the reproducing kernel for the Hilbert space is known. The principal result is the construction of the reproducing kernel for several spaces of multivariate functions. This result is then applied to the problem of finding the optimal approximation to a definite integral by a cubature sum. Some numerical examples related to approximate multiple integration are given. The results are also related to the theory of multivariate spline functions in that the optimal approximations are splines. Dissert. Abstr.

N70-40434# Aerospace Corp., El Segundo, Calif. Engineering Science Operations.
A PRACTICAL APPROACH TO NONLINEAR ESTIMATION
Laurie J. Henrikson 24 Apr. 1970 13 p refs
(Contract F04701-69-C-0066)
(AD-708473; TR-0066(5306)-19; SAMSO-TR-70-227) Avail: NTIS CSCL 12/1

One of the main purposes of the report is to take a new look, in as general terms as possible, at the requirements of many aerospace estimation problems in order to assess the value of many theoretically derived estimation algorithms for these applications. The discussion indicates some of the difficulties in applying results from probabilistic estimation to this class of problems. This provides a background of some of the factors which led to consideration of generalized least squares estimation (GLSE). The approach is discussed and is found to give a systematic approach to nonlinear estimation which provides an answer to some of the difficulties of probabilistic estimation and which lends a good deal of insight into practical estimation. Author (TAB)

N70-40447# California Univ., Los Angeles. Dept. of Mathematics.
NON-STANDARD ANALYSIS OF DYNAMICAL SYSTEMS. 1: LIMIT MOTIONS, STABILITY
A. E. Hurd [1969] 56 p refs
(Contract N00014-69-A-0200-4022)
(AD-709126) Avail: NTIS CSCL 12/1

The methods of non-standard Analysis are applied to the study of the qualitative theory of dynamical systems. The non-standard notions connected with limiting behavior of motions (limit sets, etc.) are developed, and then applied to the study of stability theory, including stability of sets, attracting properties, first prolongations and stability of motions. Author (TAB)

N70-40457 Michigan Univ., Ann Arbor.
POLARITIES ON THE LENZ-BARLOTTI CLASSIFICATION
Alan Ross Hoffer (Ph.D. Thesis) 1969 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-18023

Some interactions are considered between the combinatorial properties of polarities and the classification of projective planes which is credited to H. Lenz and A. Barlotti. After some introductory material on ternary fields each of the Lenz-Barlotti classes is described in terms of coordinate systems. With each polarity of a finite projective plane there is associated a permutation of a coordinatizing ternary field which allows for an explicit description of the polarity in terms of coordinates. From this description it is deduced that the polarity is completely determined by its action on the points of an absolute line. Ternary fields are used to describe explicitly in terms of coordinates the actions of some of those collineations which commute with a polarity, and this, in turn, is used to analyze some of the properties of the group of a polarity, e.i., the collineations of the plane which commute with the polarity. Dissert. Abstr.

N70-40460 Michigan Univ., Ann Arbor.
LINEAR FUNCTIONALS ON NON-LOCALLY CONVEX SPACES
Joel Harold Shapiro (Ph.D. Thesis) 1969 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-18108

A linear topological space has the Hahn-Banach Extension Property (HBEP) if every continuous linear functional on a closed subspace has a continuous linear extension to the whole space. The Hahn-Banach theorem implies that every locally convext space has the HBEP, and examples are known of nonlocally convex spaces with the HBEP. In this work relationship between the HBEP and local convexity is studied. A complete linear metric space with a basis must be locally convex if it has the HBEP proved. Finally, the methods are applied to the problem of obtaining proper, closed, weakly dense subspaces in some other nonlocally convex spaces of analytic functions. Dissert Abstr.

N70-40462 California Univ., Berkeley.
ANSOV FLOWS ON INFRAHOMOGENEOUS SPACES
Per Tomter (Ph.D. Thesis) 1969 66 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-18982

It is shown that solvable Lie groups G correspond to suspensions of Anosov diffeomorphisms on infranilmanifolds given by lattice-preserving hyperbolic automorphisms of the nilpotent Lie groups. Semisimple Lie groups correspond essentially to geodesic flows on the unit tangent bundles of the compact Clifford-Klein forms of the rank 1 symmetric spaces of noncompact type. In the general, nonsolvable case, it is shown that the radical is nilpotent; that the Levi-complement is simple of real rank 1 and can be chosen to contain alpha as a real C.S.A. The theory of group representations is used to study the ergodic properties of the flow. The main result is that the flow is always ergodic; if it is not a suspended flow it has Lebesgue spectrum; the manifold of a suspended flow is a bundle over the circle with an infranilmanifold as fiber; the eigenfunctions correspond to the characters of the circle. The methods are also extended to treat ergodic properties for Ansov diffeomorphisms. Dissert Abstr.

N70-40466 Polytechnic Inst. of Brooklyn, N.Y.
CHEBYSHEV APPROXIMATION BY RATIONAL FUNCTIONS WITH HURWITZ DENOMINATORS

John William Dougherty (Ph.D. Thesis) 1969 175 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-17786

The transfer function for any lumped parameter R-L-C network must be a rational function with Hurwitz denominator. Often the response desired for such a network fails to satisfy these requirements. Consequently, the network designer normally approximates the desired response by specifying magnitude or phase requirements for frequency response. Established is the possibility of another approach in approximating a desired response. Conditions and procedures are determined for the Chebyshev approximation of a specified function on the normalized real interval by a rational function with Hurwitz denominator. An additional constraint considered is that the zeros of the denominator also be real. Dissert. Abstr.

N70-40478 Wisconsin Univ., Madison.
BOUNDED CONTEXT PARSABLE GRAMMARS
John Hayden Williams (Ph.D. Thesis) 1969 51 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-12434

Recent advances in compiling techniques have stimulated much interest in the discovery of subsets of the set of context-free grammars for which membership in the subset is recursively decidable and for which membership in the subset implies that sentences generated by the grammar can be parsed in time linearly proportional to the length of the sentence. R. W. Floyd's notion of bounded context syntactic analysis is generalized and a class of subsets of context free grammars that we call Bounded Context Parsable grammars is defined. It is shown that any sentence of a BCP grammar can be parsed in time linearly proportional to its length. It also shows that for any specified bounds, the problem to determine whether an arbitrary context-free grammar is BCP is effectively decidable but that the problem to determine of an arbitrary context-free grammar whether there exist bounds such that it is BCP is recursively undecidable. The set of BCP grammars is compared with Floyd's sets of bounded context grammars and with D. E. Knuth's set of LR and RL grammars. It is shown that the set of languages that are BCP properly contains the set of deterministic languages of Ginsburg and Greibach. Dissert. Abstr.

N70-40482 Dartmouth Coll., Hanover, N.H.
FINITELY GENERATED IDEALS OF DIFFERENTIABLE FUNCTIONS
Ben G. Roth (Ph.D. Thesis) 1969 29 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-18659

The algebra is considered of real-valued m-times continuously differentiable functions on a connected open set equipped with the topology of uniform convergence of all derivatives on all compacted subsets. A determination of the question of which finitely generated ideals in these continuously differentiable functions are closed, is illustrated. Interest in closed principal ideals in these functions stems primarily from their connection by duality with problems of division for distributions. Information is obtained about certain finite systems of division problems from a study of closed finitely generated ideals. Dissert. Abstr.

N70-40486 Rice Univ., Houston, Tex.
APPROXIMATION OF TRANSLATION INVARIANT OPERATORS IN L(p)
David Carr Shreve (Ph.D. Thesis) 1969 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19333

The construction of numerical approximations to translation invariant operators on L(p) is discussed. Examples of the translation invariant operators are certain classes of singular integral operators. Suppose A is a translation invariant operator from L(p) to L(p), 1 <p< infinity. A difference operator A sub h is constructad with step size h, and it is shown that A sub h maps L(p) into L(p) with operator norm bounded independent of h. We give estimates for Au-A sub h u in the form of rates of convergence in L(P) norm for u lying in a suitable subspace of L(p). It follows that the norm of (Au-A sub h u) L(p) approaches 0 as h approaches 0 u epsilon L(p). Dissert. Abstr.

N70-40498 IIT Research Inst., Chicago, Ill.
NEARLY POWER-ASSOCIATIVE ALGEBRAS
Raymond Francis Coughlin (Ph.D. Thesis) 1969 37 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-18796

The multiplicative structure of algebras which satisfy the relations x(yz) + (zy)x = y(zx) + (xz)y and (x,x,x) = 0 is described. Such algebras have a Peirce decomposition relative to an idempotent which differs somewhat from the associative algebras, that is A10 = A01 = 0 which yields the vector space direct sum A = A11 + A00. Two other properties of this decomposition are A11A00 = A00A11 = 0 and xii squared Aii. Examples are presented to demonstrate that A11 and A00 need not be sub-algebras. It is also proved that every such algebra with characteristic not 2 contains an idempotent. In the case that the characteristic of the algebra is zero the algebra is power-associative. However, if the characteristic is p an example is given to show that the algebra need not be power-associative. Dissert. Abstr.

N70-40503 IIT Research Inst., Chicago, Ill.
PROJECTIVE STRUCTURES
Helen Lorraine Skala (Ph.D. Thesis) 1969 31 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-18800

A projective structure is a set A with two binary operations, the logical sum and logical product, satisfying the sum x + ((x + y) (z)) = x + ((x + z) (y)) and x((xy) + z) = x((xz) + y) and containing elements u and v such that u(x) = x = v + x, u + x, u + x = u, and v(x) = v. Although the operations of the logical sum and product need not be associative, as is seen by simple examples, it is shown that in some special cases the associative law does hold. An element p is called a point if p(x) is either p or y for each element x. It is proved that the structure A sub p generated by the set of all points of a projective structure constitute a relatively complemented modular lattice. It is shown that any permutation of an independent sequence is independent, and the structure generated by a set of independent elements constitutes a distributive lattice. Dissert. Abstr.

N70-40505 Carnegie-Mellon Univ., Pittsburgh, Pa.
SINGULAR PERTURBATIONS OF BOUNDARY VALUE PROBLEMS FOR A CLASS OF NON-LINEAR DIFFERENTIAL EQUATIONS WITH A SMALL PARAMETER
George Chia-Chu Hsiao (Ph.D. Thesis) 1969 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-19097

Certain singular perturbation problems which can be treated by what is called the method of inner and outer expansions (MIO) are studied. The differential equations which arise are of the form Lu = RM(u) where L is a linear operator, M is a nonlinear operator and R is a small paramater. Solutions of (E) are sought in an infinite region Omega. The relevant boundary conditions are u = f on delta Omega and a condition at infinity, u approaches the limit of −a. Conditions for existence of solutions of the problems are obtained and asymptotic expansions of these solutions are constructed. A precise formulation of the method (MIO) is presented and a rigorous justification is given. Dissert. Abstr.

N70-40508 Oregon State Univ., Corvallis.
ON THE GENERALIZATION OF THE DISTRIBUTION OF THE SIGNIFICANT DIGITS UNDER COMPUTATION
James Teng Wong (Ph.D. Thesis) 1969 52 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19477

The set of all positive integers is used as a sample space whose probability density function is unknown. Then a generalization of the probability distribution of the most significant digits of the set of all physical constants is obtained on the strength of: (1) a very general assumption imposed on the density function of the sample space, and (2) a generalized invariance principle. The assumption is quite weak in the sense that it merely states that the occurrence of an event containing infinitely many elementary events is not possible. The invariance principle, as is shown, is equivalent to another principle and to two functional equations. A function is constructed and, on the basis of the two foregoing stipulations that characterize the generalization, it is shown that this function is a unique solution, within a multiplicative positive constant, to another functional equation. Dissert. Abstr.

N70-40512 Carnegie-Mellon Univ., Pittsburgh, Pa.
DISCONJUGACY CRITERIA FOR SELF-ADJOINT SYSTEMS OF DIFFERENTIAL EQUATIONS
William Simons (Ph.D. Thesis) 1969 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-19107

Necessary conditions are obtained for the disconjugacy of the vector equation $(Ry')' + Py = 0$ and the scalar equation $(r(x)u$ to the (nth) power) to the (nth) power $- (-1)$ to the nth power $p(x)u = 0$. The conditions are derived from a relation which is shown to exist between the disconjugacy of the equations and the magnitude of the smallest eigenvalue of the given systems. This relation, in conjunction with the classical minimum property of the eigenvalues, leads to necessary criteria involving arbitrary functions (of certain classes). By appropriate choice of the functions, these criteria lead to explicit disconjugacy conditions. Dissert. Abstr.

N70-40513 IIT Research Inst., Chicago, Ill.
A4 ALGEBRAS
Harold Robert Andrews (Ph.D. Thesis) 1969 30 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-18795

Nonassociative algebras are usually defined by a particular behavior of the associator $(x, y, z) = (xy)z - x(yz)$, and an A4 algebra is defined as a class of algebras which extend the well known class of alternative algebras. If A is an algebra over an arbitrary field F, and $(x, x, x, y) = (y, x, x, x) = 0$, for all x, y in A, then A is by definition an A4 algebra. It is shown that if an algebra is alternative then it is an A4 algebra, and examples are given of algebras which are A4 and fail to be alternative. A4 algebras that have an identity element are necessarily alternative, and it is proved that (a) flexible, A4 algebras over fields of characteristic not equal to 2, 3, or, 5, which are simple and satisfy $(x \text{ squared}, x, x) = (x, x, x \text{ squared})$, are necessarily alternative, and (b) simple, A4 algebras over fields of characteristic zero, satisfying $(x, x, x) = 0$ and $(x, y, x) = (x, x, y)$ are alternative. Dissert. Abstr.

N70-40534 Rice Univ., Houston, Tex.
IMPROVEMENT OF CATALYTIC SELECTIVITY BY PERIODIC OPERATION
James Edwin Bailey (Ph.D. Thesis) 1969 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-19265

Three general methods applicable to any control problem described by ordinary differential equations are developed for comparing steady-state with periodic operation. The first follows from the application of Pontryagin's Maximum Principle to a class of problems in optimal periodic operation, while another involves comparisons of tangent cones of pointsets in P space. The final approach utilizes the concept of relaxed operation, which leads to a simple procedure for calculating the results obtained by rapid periodic switching of the control among admissible values. A lumped-parameter and a distributed-parameter model of mass transfer resistance are analyzed. By extending the concept of relaxed operation to an ideal packed tubular reactor, it is shown that nontrivial effects may result from rapid periodic variations in feed composition. Dissert. Abstr.

N70-40545 Emory Univ., Atlanta, Ga.
INVERSE PROPERTY LOOPS AND RELATED STEINER TRIPLE SYSTEMS
Anne Christine Cole Treash (Ph.D. Thesis) 1969 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-19618

A Steiner triple system of order n is a set of n elements together with a list of three-element subsets, called triples, such that each distinct pair of elements occurs in exactly one triple. It is well known that Steiner triple systems and finite TS loops are isomorphic algebraically. Hence the embedding problem for TS loops corresponds to the same problem for triple systems; and any result for triple systems can be translated into a corresponding result for TS loops. Several methods of construction which are useful in completing special triple systems are described in the thesis. The most important construction is the well-known method of obtaining a system of order $2n + 1$ from a triple system of order n. This involves taking the direct product of the TS loop which corresponds to the given Steiner triple system of order n, with a two element TS loop (which is a group). Using this simple construction carefully it is possible to prove by induction that every finite incomplete Steiner triple system can be embedded in a finite complete triple system. This gives the finite embeddability property for TS loops. Dissert. Abstr.

N70-40548# Aberdeen Univ. (Scotland).
PROBLEMS IN PARTITION THEORY AND RELATED TOPICS Final Technical Report, May 1969 – Apr. 1970
E. M. Wright May 1970 99 p refs
(Contract DAJA37-69-C-1115)
(AD-708584; ARDG(E)-E-1355(2)) Avail: NTIS CSCL 12/1

The previous complicated proof by the author of the asymptotic approximation to T sub nq, the number of graphs on n unlabelled nodes with q edges has been shortened and simplified. An almost complete arithmetical theory for H sub n)(1), Eulers rencontre number, the number of permutations of n different objects in which no object remains unmoved, has been developed. The corresponding arithmetical theory and the asymptotic theory for (H sub n)(k), the number of permutations of n objects whose expression as a product of disjoint cycles contains no cycle of length less than k+1, has been studied. The combinatorial structures known as stacks have been further studied. Author (TAB)

N70-40557# Naval Postgraduate School, Monterey, Calif.
A BRANCH-AND-BOUND ALGORITHM FOR THE SOLUTION OF SEQUENCE DEPENDENT ROUTING PROBLEMS
Michael Joseph de Haemer (M.S. Thesis) Apr. 1970 57 p refs
(AD-709059) Avail: NTIS CSCL 12/2

A branch-and-bound algorithm, which finds the optimal route through n nodes when a different cost matrix occurs after each arc in the sequence is traversed, is presented. The route may begin at any node and must pass through each of the n nodes exactly once. The objective is to minimize total cost in traversing

(n-1) arcs of the route. The cost of traversing each arc is (r sub (ij)) sup k, which is a function of the distance between nodes j and j and a function of the kth position in the sequence of arcs forming the route. The algorithm is presented in step-by-step detail and illustrated by flow chart and examples. A modification for symmetric (r sub (ij)) sup k improves the efficiency of the algorithm. A trade-off between computation time and storage requirements may be accomplished by alternate branching policies. Suboptimal solutions may be obtained with reduced computation. Author (TAB)

N70-40585 Boston Univ., Mass.
AN INVERSE PROBLEM IN THE THEORY OF UNIFORM LINEAR APPROXIMATION
Peter Wayne Lindstrom (Ph.D. Thesis) 1969 54 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-18785

A problem is solved motivated by a known result in the theory of uniform linear approximation. The approximation of functions in C[0] by linear combinations of n independent functions f sub 1 (x), F sub 2 (x) .... F sub n (x) is dealt with. An inverse problem is solved and corollaries are proved and applied to specific examples. Dissert. Abstr.

N70-40583 University of Southern Calif., Los Angeles.
TERMINAL STATE DYNAMIC PROGRAMMING
David Christopher Collins (Ph.D. Thesis) 1969 195 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-17876

Many interesting and important physical and mathematical problems can be posed as terminal control problems. One type of terminal control problem involves minimizing a cost function. Numerical solutions for control problems of this type can often be acquired by employing algorithms suggested by the application of the calculus of variations or dynamic programming approaches. Both of these approaches can lead to algorithms that are difficult to implement on a digital computer; the calculus of variations can lead to unstable, nonlinear, two-point boundary value problems, while dynamic programming can result in excessive demands on computer rapid-access storage and time. Dissert. Abstr.

N70-40587 California Univ., Berkeley.
THE UNIQUENESS OF THE CAUCHY PROBLEM FOR PARTIAL DIFFERENTIAL EQUATIONS WHICH MAY HAVE MULTIPLE CHARACTERISTICS
Peter Mike Goorjian (Ph.D. Thesis) 1969 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-18926

The uniqueness of solutions to the Cauchy problem is proven across convex surfaces for partial differential equations of order m with constant leading coefficients and with complex characteristics of multiplicity at most r. Also uniqueness of the Cauchy problem is proven across arbitrary surfaces for certain elliptic equations of order m with Lipschitz continuous leading coefficients, with characteristics of multiplicity at most r. The uniqueness of the Cauchy problem is proven for solutions across convex surfaces for parabolic equations in which the elliptic part of the operator has constant coefficients and characteristics of multiplicity at most r. Dissert. Abstr.

N70-40590 California Univ., Berkeley.
GROUP-COMPLEXITY AND p-LENGTH OF FINITE SEMIGROUPS
Bret Ransom Tilson (Ph.D. Thesis) 1969 126 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-18961

It is first shown that semigroups having at most one idempotent in each R class have complexity equal to one. This class of semigroups includes inverse and commutative semigroups and, most importantly, is closed under the operations of division and semidirect products. The proof rests on a detailed analysis of how one J class can act on another below it. The p-length portion of the study extends the concept of p-length for finite groups to finite semigroups and shows p-length to be a generalization of complexity. Methods for computing the p-length of p-solvable semigroups in terms of certain homomorphism series of the semigroup are developed. Dissert. Abstr.

N70-40591 Rice Univ., Houston, Tex.
NON-TANGENTIAL HOMOTOPY EQUIVALENCES
Victor Allen Belfi (Ph.D. Thesis) 1969 37 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19267

A procedure is given for obtaining manifolds which are homotopy equivalent but not homeomorphic to smooth pi-manifolds of the form N(4k) $\times$ L(m) where k $>$ or $=$ to 2 and pi sub 1 (L) = 0. The manifolds obtained are smooth, but the homotopy equivalences are not stable tangential maps. Specifically, we prove the following theorem: Suppose N(4k) is a smooth closed pi-manifold and L is a smooth, closed, simply connected pi-manifold. Then there is a countable sequence of smooth closed manifolds set of M sub i having the following properties: (1) no M sub i is a pi-manifold. (2) each M sub i is homotopy equivalent but not homeomorphic to N $\times$ L. (3) M sub i is not homeomorphic to M sub j if i is not equal to j. The proof of this theorem is an application of Browder-Novikov surgery and a product formula for surgery obstructions. The main corrollary for which this theorem was designed is an application to simply connected compact Lie groups. Dissert. Abstr.

N70-40595# California Univ., Los Angeles. Dept. of Mathematics.
BEHAVIOR OF P-HARMONIC FUNCTIONS AT THE P-SINGULAR POINT OF A RIEMANN SURFACE Interim Technical Report
Joel Linn Schiff (Ph.D. Thesis) Jun. 1970 95 p refs
(Grant DA-ARO-D-31-124-70-G7)
(AD-708890; TR-48; AROD-6929:42-M) Avail: NTIS CSCL 12/1

The P-algebra and the P-compactification of an open Riemann surface R are defined. A maximum principle is given for PE-functions and an integral representation of these functions in terms of a kernel function and a measure on the P-harmonic boundary. Author (TAB)

N70-40601 City Univ. Of New York.
THEORY OF SOLVMANIFOLDS
Richard Tolimieri (Ph.D. Thesis) 1969 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-19070

A study of simply connected solvable analytic groups and quotient spaces of such groups by closed subgroups is presented. Such spaces will be called solvmanifolds. The major tool will be the theory of algebraic groups essentially as developed by Borel, Chevalley, and Mostow. Simply connected nilpotent analytic groups are studied first. Using the Birkhoff imbedding theorem this problem is reduced to problems about algebraic subgroups of U(n), the group of all unipotent upper triangular matrices. The main theorem will be related to the fact that a closed subgroup is cocompact in an algebraic subgroup of U(n) (i.e., has compact quotient) with it being Zariski dense. A different and somewhat generalized way the results of Malcev's paper on homogeneous spaces are proved. What is crucial are the methods for they show that the questions of the Malcev paper are purely algebraic. Dissert. Abstr.

N70-40603 Emory Univ., Atlanta, Ga.
SOME PROBLEMS CONCERNING FREE ALGEBRAS
David Michael Clark (Ph.D. Thesis) 1969 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19604

A chain of varieties of binary algebras and the nature of the defining identities of these varities are studied. The main result is that there is no finite set of defining identities for the variety of disassociative groupoids. Several structural problems and decision problems for nonassociative linear algebras are solved. A translation is given of a paper in which the word problem for finitely presented nonassociative linear algebras is solved. Similar techniques are used to determine the structure of finitely generated subrings and the automorphism groups of free nonassociative linear algebras. Varieties are investigated which have the curious property that free algebras on finite sets of different cardinal numbers are isomorphic. This situation can not occur in any variety which contains a nontrivial finite algebra. The question arises as to what subsets M of the positive integers have the property that there is an algebra F in a variety V such that the free V-algebra on n generators is isomorphic to F if and only if n is in M. It is shown that M has the property if and only if it is an arithmetic progression. Dissert. Abstr.

N70-40613 Wisconsin Univ., Madison.
CROSS SECTIONALLY CONNECTED SPHERES
Richard Allen Jensen (Ph.D. Thesis) 1969 25 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-12382

The nature of embeddings of a spherical surface in Euclidean 3-dimensional space is studied. If there is a homeomorphism of 3-space onto itself which takes the spherical surface onto a round sphere then the surface is said to be tame. For each simple closed curve in the plane, there is a homeomorphism of the plane onto itself which takes the simple closed curve onto a round circle. However, numerous examples of spherical surfaces in 3-space were discovered which are not tame. Accordingly, great effort was expended to find conditions on spherical surfaces which will imply that they are tame. It was shown that a spherical surface in 3-space is tame if each of its horizontal cross sections is a simple closed curve or a point. Dissert. Abstr.

N70-40621# Association pour l'Etude et la Recherche en Traitement de l'Information, Paris (France).
ALGEBRAIC METHODS IN AUTOMATA THEORY, PART 1 AND 2 Final Scientific Report, 15 Mar. 1966 - 31 Aug. 1969
Marco P. Schutzenberger and Maurice P. Nivat Sep. 1969 13 p refs
(Contract AF 61(052)-945)
(AD-708528; AFOSR-70-1855TR) Avail: NTIS CSCL 6/4

The report summarizes research on algebraic tools that have applicability to automata and language theory. The problem of determining the structure of two words generating a free submonoid (i.e., that are not linked by any algebraic relation) was solved. The conjecture of Gilbert and Moore on the existence of a non-prefix finite complete code with bounded delay (in the theory of variable length codes) was proved. The structure of rational (i.e., regular) sets in finitely generated commutative monoids has been described. A mathematical framework was developed for the description of the rational subsets of the cartesian product of two free monoids. Several generalizations of standard theorems in the theory of algebraic languages and power series have been stated in concise algebraic form. A subclass of languages was identified for which an attempt was made to prove the decidability of the equivalence problem; a construction was developed that relates images of the Dyck set in an inverse homomorphism to some special types of Thue congruence on a free monoid. An analysis of sets and co-sets of algebraic languages showed that there exists a language which has just one grammar up to trivial changes. A notion of constellation is being developed that permits the transformation of many graph theoretic and combinatorial problems into problems about algebraic languages or power series in non-commuting variables. (TAB)

N70-40642 Czechoslovak Academy of Sciences, Prague.
ON THE FUNCTIONAL COMPLETENESS IN MULTIVALUED LOGICS [UEBER DIE FUNKTIONALE VOLLSTAENDIGKEIT IN DEN MEHRWERTIGEN LOGIKEN]
Ivo Rosenberg 1970 95 p refs In GERMAN *Its* Ser. of Math. and Nat. Sci., Vol. 80, No. 4
Copyright. Avail: Issuing Activity

A solution to the problem of functional completeness in multiple value logic is found by determining all necessary and adequate conditions so that each function represents a superposition of the given function system A of the multiple value logic; A represents a complete logic. Established are all maximum sub-classes in a system of closed function classes of a k-valued logic. Transl. by G.G.

N70-40661 Rice Univ., Houston, Tex.
A PRIORI ESTIMATES AND UNIQUE CONTINUATION THEOREMS FOR SECOND ORDER PARABOLIC EQUATIONS
Raymond Lewis Johnson (Ph.D. Thesis) 1969 54 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19305

For the given differential operator, it is assumed that the matrix (a sub ij) is symmetric, uniformly positive definite and bounded above, and that its entries are uniformly Hoelder continuous. Assume that b sub i and c have extensions in the time variable as holomorphic functions of t, and the extended functions are Hoelder continuous in x, uniformly on compact subsets of $t \neq 0$. For a given u as a solution of $Lu = 0$, a unique continuation theorem is derived. Dissert. Abstr.

N70-40663 California Univ., Los Angeles.
STUDIES OF THE TWO-DIMENSIONAL TRANSPORT EQUATION
Ahmad Sotoodehnia-Korrani (Ph.D. Thesis) 1969 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilms $3.00 Order No. 69-17567

The two-dimensional time independent monoenergetic integrodifferential Boltzmann transport equation with isotropic scattering is investigated for different geometrical configurations. The geometries are the full-, half-, and quarter-space and the finite slab. For each case the solutions are obtained in terms of discrete and continuum modes and the correction terms due to the finite boundaries in half- and quarter-space and in slab problems are obtained. The two-dimensional Boltzmann transport equation is reduced to a form similar to the one-dimensional transport equation by a Fourier transformation of the y variable (one of the spatial variables). The elementary solutions for this reduced equation are obtained and the completeness of these solutions is proved by solving a generalized Riemann-Hilbert problem. Dissert. Abstr.

N70-40728*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOME EXPERIMENTAL RESULTS CONCERNING THE ERROR PROPAGATION IN RUNGE-KUTTA TYPE INTEGRATION FORMULAS
Erwin Fehlberg Washington Oct. 1970 44 p refs
(NASA-TR-R-352; M-530) Avail: NTIS CSCL 12A

The global error propagation of Runge-Kutta formulas is discussed. The more conventional approach using the integrated differential equation for the error propagation is given and two-sided

(or bilateral) Runge-Kutta formulas are derived. Knowledge of the leading term of the local truncation error is essential for both approaches. Author

N70-40738# Iowa Univ., Iowa City. Dept. of Mathematics.
ON SOME CLASSES OF H-SEMIGROUPS
Mary Joel Jordan May 1970 76 p refs
(Contract N00014-68-A-0500; Proj. Themis)
(AD-708420; THEMIS-UI-TR-22) Avail: NTIS CSCL 12/1

The report further develops the study of H-semigroups introduced by R.H. Oehmke. Several characterizations arise which make possible the identification of maximal modular congruences. A semigroup S is an inverse H-semigroup if and only if S is a semilattice of disjoint Hamiltonian groups. From this it follows that sigma is a maximal modular congruence on S if and only if S/sigmais a cyclic group of prime order or S/sigma = (0,1). In the setting of automaton theory, sigma is a maximal modular congruence on S if and only if its related automaton is either strongly connected or strongly irreducible and of cardinality two. For each idempotent e of S there is a maximal modular congruence sigma on S such that its related automaton is strongly irreducible and of cardinality two with sigma sub e as a strict generator where e is the minimum idempotent in sigma e. S is t-semisimple if and only if for each nonidempotent element g of S there is a maximal modular congruence sigma on S such that its related automaton is strongly connected and has sigma sub g as a strict generator. Author (TAB)

N70-40746# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
ESTIMATION AND CONFIDENCE INTERVALS FOR QUANTAL RESPONSE OR SENSITIVITY DATA
Guy Burton Seibert, Jr. (Ph.D. Thesis) 25 Feb. 1970 70 p refs
(Contract N00014-68-A-0515)
(AD-709052; THEMIS-SMU-TR-66) Avail: NTIS CSCL 12/1

If different levels of stimuli are applied and then counts are made of the number reacting and not-reacting to the stimuli, a sensitivity analysis is usually the best analysis to be applied. Sensitivity analysis may be used to determine the probability of destroying a target with different size bombs, without the necessity of actually having data on all the different sizes. It may also be used in determining the effect of a drug on a patient or the effect of polution on a body of water. This paper is concerned with a generalized model for sensitivity analysis based on the Burr distribution. This generalization gives a model that will fit quite well data that comes from probit or logit models, but also covers many additional situations that the probit or logit models would not fit. A FORTRAN IV program is included for doing the analysis on a computer. Confidence intervals for any quantile are also given. Author (TAB)

N70-40753# Naval Postgraduate School, Monterey, Calif.
A COMPARISON OF CONFIDENCE INTERVAL PROCEDURES IN CENSORED LIFE TESTING PROBLEMS
William Eugene Coleman (M.S. Thesis) Jun. 1970 24 p refs
(AD-709062) Avail: NTIS CSCL 12/1

Obtaining a confidence interval for a parameter lambda of an exponential distribution is a frequent occurrence in life testing problems. Oftentimes the test plan used is one in which all the observations are censored at the same time point. Several approximate confidence interval procedures are available in the statistical literature; however, to the knowledge of the author, the performance characteristics of the various approximations used in these procedures have not been established analytically. The purpose of this paper is to report the results of an empirical study of the performance of four of these procedures with respect to the expected length of the interval, the variance of the interval length, and the coverage probability. Author (TAB)

N70-40774# Wisconsin Univ., Madison. Dept. of Statistics.
BAYESIAN ANALYSIS OF A GENERALIZED REGRESSION MODEL OF POTTHOFF AND ROY
W. Y. Tan May 1970 44 p refs
(Contract Nonr-1202(17))
(AD-708404; UWIS-DS-70-235) Avail: NTIS CSCL 12/1

A Bayesian approach was adopted to derive some inference procedures for the parameters theta and the covariance matrix in the generalized regression model under normality assumption, Y = A theta B + U. The likelihood ratio test procedure for some linear hypothesis H sub 0: C D = psi sub 0 is also derived and compared with the Bayesian procedures. Author (TAB)

N70-40801# New York Univ., N.Y.
ON THE EXISTENCE AND USE OF ALGORITHMS Final Report
Martin D. Davis Jun. 1970 10 p refs
(Grant AF-AFOSR-1482-68)
(AD-708529; AFOSR-70-1854TR) Avail: NTIS CSCL 12/1

A complete solution to the problem of locating a sharper estimate than Bachmann for the closure of Finslers arithmetic operations was sought and found. A proof was also developed to show a correspondence between Schuttes ordinal notation and Takeutis system of ordinal diagrams. Significant work was done in identifying certain sets as Diophantine. Five solvable cases of word problems for semi-groups were identified as solvable, and three systems of unary second order languages were studied with respect to finite axiomaticability, decision problems, and classification of equivalence models. This work effort should materially contribute to work on mechanized theorem proving and should significantly reduce the amount of time needed to reach solutions conventionally obtained under standard encoding methods and execution techniques. Author (TAB)

N70-40809# California Univ., Los Angeles. School of Engineering and Applied Science.
CONTRIBUTIONS TO THE THEORY AND APPLICATIONS OF PURSUIT-EVASION GAMES
Ho-Sen Lin (Ph.D. Thesis) Apr. 1970 150 p refs
(Contract F04701-69-C-0182; Grant AF-AFOSR-699-67)
(AD-708477; UCLA-70-22; AFOSR-70-1848TR) Avail: NTIS CSCL 12/2

Two phases of pursuit-evasion games are considered. The first deals with the problem of completion of a class of pursuit-evasion games. The other is concerned with the computational aspects of nonlinear differential games. In the first part, necessary and sufficient conditions for completion of a game are derived. The problem of existence of the optimal completion time and optimal strategies are analyzed. Also, methods used in obtaining solution are developed. Several numerical examples are given to clarify the presentation. In the second part, a detailed comparison between control problems and differential games is given. The difficulties in extending game problems are also discussed. A differential game between a maneuverable ballistic re-entry vehicle and an interceptor is presented. Author (TAB)

N70-40811# California Univ., Los Angeles. School of Engineering and Applied Science.
PROBLEMS OF SINGULARITY AND DUALITY IN LINEAR ESTIMATION AND CONTROL
Kurt William Simon (Ph.D. Thesis) Apr. 1970 78 p refs
(Contract F04701-69-C-0182; Grant AF-AFOSR-699-67)
(AD-708480; UCLA-70-26; AFOSR-70-1850-TR) Avail: NTIS CSCL 12/1

Results in the estimation of the state of linear systems in the presence of Gauss-Markov noise processes are examined and a new proof is provided for these results. The results are then

extended in several directions, namely: to continuous-time filtering of systems with measurements corrupted by noise with non-invertible covariance matrix; to optimal control problems whose cost is not a positive-definite function of the control; and to discrete-time colored-noise filtering problems. The extension to optimal control is accomplished by exploiting the duality of linear estimation and control, which is derived from duality concepts in mathematical programming. The extension to discrete-time filtering is further extended to provide a useful method of reducing the number of simultaneous equations required by the usual white-noise, discrete-time Kalman filter. Author (TAB)

N70-40813*# Texas Center for Research, Austin.
COMPUTING PROCEDURES IN STATISTICAL DISCRIMINATE ANALYSIS Three Lectures
Patrick L. Odell (Tex. Tech. Univ.) Jul. 1969 61 p refs Presented at NASA. Manned Spacecraft Center, Houston, Jul. 1969
(Contract NAS9-9903)
(NASA-CR-108650) Avail: NTIS CSCL 12A

CONTENTS

1. NONPARAMETRIC DISCRIMINATION TECHNIQUES P. L. Odell, T. G. Newman (Tex. Tech. Univ.), and M. Speed (NASA. Manned Spacecraft Center, Houston) p 4–25 refs (See N70-40814 23-19)

2. ON COMPUTING MINIMAX PROCEDURES IN DISCRIMINATION ANALYSIS P. L. Odell and T. G. Newman (Tex. Tech. Univ.) p 26–37 refs (See N70-40815 23-19)

3. WILK'S SCATTER TECHNIQUES AND STATISTICAL DISCRIMINATION P. L. Odell and T. G. Newman (Tex. Tech. Univ.) p 38–49 refs (See N70-40816 23-19)

N70-40814*# Texas Center for Research, Austin.
NONPARAMETRIC DISCRIMINATION TECHNIQUES
P. L. Odell (Tex. Tech. Univ.), T. G. Newman (Tex. Tech. Univ.), and M. Speed (NASA. Manned Spacecraft Center, Houston) *In its* Computing Procedures in Statist. Discriminate Analysis Jul. 1969 p 4–25 refs (See N70-40813 23-19)
(Contract NAS9-6963)
Avail: NTIS CSCL 12A

Nonparametric techniques for performing statistical discrimination are presented. Nonparametric techniques are defined as the mathematical form of the multivariate probability density functions of the populations which are unknown to the experimenter. Discrimination problems and mathematical matrices involved in statistical analysis are presented. Author

N70-40815*# Texas Center for Research, Austin.
ON COMPUTING MINIMAX PROCEDURES IN DISCRIMINATION ANALYSIS
P. L. Odell (Tex. Tech. Univ.) and T. G. Newman (Tex. Tech. Univ.) *In its* Computing Procedures in Statist. Discriminate Analysis Jul. 1969 p 26–37 refs (See N70-40813 23-19)
(Contract NAS9-6963)
Avail: NTIS CSCL 12A

The theory of statistical discriminate analysis based on a Bayes theorem and on a minimax criteria of evaluation is discussed. Fundamental concepts and techniques for problem solving are presented. Author

N70-40816*# Texas Center for Research, Austin.
WILK'S SCATTER TECHNIQUES AND STATISTICAL DISCRIMINATION
P. L. Odell (Tex. Tech. Univ.) and T. G. Newman (Tex. Tech. Univ.) *In its* Computing Procedures in Statist. Discriminate Analysis Jul. 1969 p 38–49 refs (See N70-40813 23-19)
(Contract NAS9-6963) Avail: NTIS CSCL 12A

A concept of multidimensional scatter for reducing the dimension of some statistical discriminate problems is discussed. Mathematical models and matrices are presented which minimize expected cost of misclassification or minimize maximum expected costs of misclassification. Author

N70-40820# California Univ., Los Angeles. Numerical Analysis Research.
GENERATION OF SEMI-GROUPS OF NONLINEAR TRANSFORMATIONS ON GENERAL BANACH SPACES
M. G. Crandall and T. M. Liggett 1970 53 p refs
(Contract N00014-69-A-0200; Grant AF-AFOSR-1781-69)
(AD-708451) Avail: NTIS CSCL 12/1

The authors continue a discussion of a problem posed by Hille (1951) in a paper titled, On the Generation of Semigroups and the Theory of Conjugate Functions. TAB

N70-40836*# Arizona Univ., Tucson.
SECOND ORDER ENDPOINT CONDITION
Richard G. Brusch and Thomas L. Vincent Mar. 1970 66 p refs
(Grant NGR-03-002-011)
(NASA-CR-113801) Avail: NTIS CSCL 12A

The nature of multiple solutions to a general problem of Bolza in the calculus of variations is investigated. Multiple stationary solutions often arise when only first order necessary conditions have been applied. A second order test to eliminate some multiple solutions of this type is developed. It is shown that second order tests can be broken down into path tests and endpoint tests and that once the first order necessary conditions of the calculus of variations have been applied, the second order path test and the endpoint test can be applied independently. Only the second order endpoint test is investigated. Direct application of this condition requires the analytical integration of a set of nonlinear differential equations subject to mixed boundary conditions. Since this is often difficult or impossible, an algorithm is developed for numerically implementing the second order endpoint condition. A geodetics problem is solved analytically to illustrate the theory and demonstrates that the second order condition is an effective computational tool, by eliminating certain classes of nonoptimal solutions from consideration. Author

N70-40837*# Brown Univ., Providence, R.I. Div. of Applied Mathematics.
NECESSARY CONDITIONS FOR DISCRETE PARAMETER STOCHASTIC OPTIMIZATION PROBLEMS
Harold J. Kushner Jul. 1970 50 p refs Submitted for publication
(Grants NGL-40-002-015; NSF GK-2788; AF-AFOSR-0693-67A)
(NASA-CR-113800; TR-70-3) Avail: NTIS CSCL 12A

Some recent developments in abstract programming are employed to obtain necessary conditions for (local) optimality of several discrete parameter optimization problems. Computational procedures are demonstrated for the programming approach, and the results obtained appear to extend most previous discrete parameter results. D.L.G.

N70-40892# Institute for Advanced Study, Princeton, N.J.
ON NILPOTENT LOCALLY CONVEX LIE ALGEBRAS
N. Limic [1970] 31 p refs Sponsored by NSF
Avail: Issuing Activity

The infinite-dimensional Lie algebras with the locally convex topological structures which are the analogue of the nilpotent finite-dimensional Lie algebras and possible groups related with these algebras are discussed. Definitions of different classes of the locally convex Lie algebras, the analogue of which in the case of

the finite-dimensional Lie algebras are always the nilpotent Lie algebras, are given. The relation between certain topological groups and the locally convex Lie algebras is shown. A construction of the groups is presented and the connection of the unitary representations of the groups and the representations of the related locally convex Lie algebras is considered. The possible application of the developed theory in some problems of theoretical physics is indicated. Author

N70-40898*# Stanford Univ., Calif. Digital Systems Lab.
CELLULAR AUTOMATA THEORY
Alvy Ray Smith, III Dec. 1969 121 p refs
(Grant NGR-05-020-337; Contract DAHC04-69-C-0082)
(NASA-CR-113809; SU-SEL-70-016; TR-2) Avail: NTIS CSCL 12A

The formal definitions for the n-dimensional generalization of cellular spaces are presented, and the general theory of these spaces as mathematical objects is developed. It is established that there is a canonical class of minimal neighborhoods with n + 1 neighbors for an n-dimensional space. A specialization to those cellular automata which compute the partial recursive functions is presented. A solution to an open coding theory problem and a tantative step toward exploitation of the inherent high parallelism of cellular automata are included. Author

N70-40905# Iowa Univ., Iowa City. Dept. of Mathematics.
DISCONNECTED COLORINGS OF GRAPHS
Stephen T. Hedetniemi Jun. 1970 35 p refs
(Contract N00014-68-A-0500; Proj. Themis)
(AD-708421; THEMIS-UI-TR-23) Avail: NTIS CSCL 12/1

Results are presented for D-colorings and chi sub d which are very similar to corresponding results that have been established for the traditional colorings and chromatic number chi (G) of graphs; in particular analogs are given for established results on (1) bounds for the chromatic and achromatic number, (2) colorings of planar graphs, (3) critical graphs, (4) the line-chromatic number, and (5) uniquely-colorable graphs. These new results indicate that the established results reveal much less about properties of colorings than they do about concepts which are much more general. They also reveal that most of the established results on coloring are really very simple. One conclusion that can be drawn from this is that one has not learned very much yet about the concept of coloring a graph. Another conclusion is that there is now emerging a new theory of partitions of graphs of which the theory of colorings is but a part. Author (TAB)

N70-40906# Rice Univ., Houston, Tex. Dept. of Mechanical and Aerospace Engineering and Materials Science.
MODIFIED QUASILINEARIZATION AND OPTIMAL INITIAL CHOICE OF THE MULTIPLIERS. PART 1: MATHEMATICAL PROGRAMMING PROBLEMS
A. Miele and A. V. Levy 1970 32 p refs
(Grant NSF GP-18522)
(AAR-76-Pt-1) Avail: Issuing Activity

The problem of extremizing a function f(x) subject to the constraint phi(x) = 0 is considered. A modified quasi-linearization algorithm is developed. A method for selecting phi optimally is presented, and the performance index R is minimized with respect to phi. Numerical solutions are presented, and it is shown that, if the initial multiplier is chosen optimally, modified quasi-linearization converges to the solution. If the initial multiplier is chosen arbitrarily, modified quasi-linearization may or may not converge to the solution. It is concluded that the beneficial effect associated with the optimal initial choice of multiplier lies in increasing the likelihood of convergence rather than accelerating convergence. Author

N70-40907# Rice Univ., Houston, Tex. Dept. of Mechanical and Aerospace Engineering and Materials Science.
MODIFIED QUASILINEARIZATION AND OPTIMAL INITIAL CHOICE OF THE MULTIPLIERS. PART 2: OPTIMAL CONTROL PROBLEMS
A. Miele, R. R. Iyer, and K. H. Well 1970 50 p refs
(Grant NSF GP-18522)
(AAR-77-Pt-2) Avail: Issuing Activity

The problem of extremizing a functional I which depends on the state x(t), the control u(t), and the parameter pi, is considered. Along the interval of integration, the state, the control, and the parameter are required to satisfy n scalar differential equations. A modified quasi-linearization algorithm is developed. A method for selecting lambda(t) and mu optimally is presented and the performance index R is minimized. Numerical solutions are presented, and it is shown that, if the initial multipliers lambda(t) and mu are chosen optimally, modified quasi-linearization converges rapidly to the solution. If the initial multipliers are chosen arbitrarily, modified quasi-linearization may or may not converge to the solution. It is concluded that the benefits associated with the optimal initial choice of the multipliers lambda(t) and mu lies in increasing the likelihood of convergence rather than accelerating convergence. Author

N70-40982# North Carolina Univ., Chapel Hill. Dept. of Statistics.
MATCHING THEOREMS FOR COMBINATORIAL GEOMETRIES Interim Report
Martin Aigner and Thomas A. Dowling Repr. from Bull. Amer. Math. Soc., v. 76, no. 1, Jan. 1970 p 57-60 refs
(Grants AF-AFOSR-1406-68; NSF GU-2059)
(AD-708945; AFOSR 70-1925TR) Avail: NTIS CSCL 12/1

Let (G(S) and G(T) be combinatorial geometries of finite rank on sets S and T, respectively and let R contained in S x T be a binary relation between the points of G(S) and G(T). By a matching from G(S) into G(T) one understands a one-one function f from an independent set A contained in S onto an independent set B contained in T with (a,f(a)) contained in R for all a epsilon A. In this note, a characterization of matchings of maximum cardinality, a mas-min theorem, and a number of related results are presented. TAB

N70-40988# Naval Postgraduate School, Monterey, Calif.
METHODS OF ESTIMATING THE TWO PARAMETERS OF LIFE DISTRIBUTION CHARACTERIZED BY A LINEAR INCREASING FAILURE RATE, a + 2bt
Gene R. Farmelo (M.S. Thesis) Apr. 1970 43 p refs
(AD-709109) Avail: NTIS CSCL 14/4

The assumption of a linear increasing failure rate uniquely determines a life distribution which has mathematically tractable qualities. The pertinent features of this distribution are derived and listed in the paper. Three methods of estimating the two parameters of the linear increasing failure rate are derived. For each procedure a computer program is provided which performs the necessary calculations. Results using simulated failure data are listed for two of the methods of parameter estimation. Author (TAB)

N70-40989# Naval Postgraduate School, Monterey, Calif.
SUBSEMIGROUP STRUCTURE OF FINITE TRANSFORMATION SEMIGROUPS
James Charles Higgins, III (M.S. Thesis) Jun. 1970 33 p refs
(AD-709114) Avail: NTIS CSCL 12/1

Both necessary conditions and sufficient conditions in order that a subset of a finite transformation semigroup be a subsemigroup are developed in this paper. The existence of several subsemigroups of various orders is established. Also, some results concerning idempotents and generators of idempotents are proved. Then certain classes of subsemigroups are defined according to their idempotent

structure and isomorphisms are demonstrated between these classes. Examples from the transformation semigroup on three elements are supplied throughout the paper. Author (TAB)

N70-41015# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF THE ACCURACY OF USING STEADY-STATE RESULTS TO APPROXIMATE ACTUAL SYSTEM AVAILABILITY
George Richard Catron (M.S. Thesis) Apr. 1970 42 p refs
(AD-709098) Avail: NTIS CSCL 15/5

Values of system availability are computed for a system whose failure density is exponential and whose repair density is special Erlang. The system is modeled as an alternating renewal process. The Laplace transform of the availability function is developed and inverted (by using a numerical procedure) to obtain the values of the system availability. Corresponding values of the long-run average system availability and the average availability over the first mission time are also computed. Comparisons are made which establish that using the long-run average value to approximate the true availability over the first mission time is a conservative practice. Author (TAB)

N70-41020# George Washington Univ., Washington, D.C. Program in Logistics.
SOME RESULTS FOR QUEUES WITH STATE-DEPENDENT ERLANG SERVICE
Carl M. Harris (Res. Analysis Corp.) 15 Jun. 1970 18 p refs
(Contract N00014-67-A-0214)
(AD-709147; T-236) Avail: NTIS CSCL 12/2

Some general results are derived for single-channel queues with Poisson input and state-dependent Erlang service times in view of the possible use of this model to approximate arbitrary M/G/1-like state-dependent queues in a manner similar to that suggested for M/G/1 by Kendall, and Kotiah, Thompson, and Waugh. Numerical procedures are indicated for the evaluation of steady-state probabilities, expected system sizes and waiting times, and parameter estimation. Author (TAB)

N70-41034# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF A NEW CLASS OF LINEAR FINITE DIFFERENCE OPERATORS TO BE USED IN SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS
Gerald Frietas Dias (M.S. Thesis) Jun. 1970 66 p refs
(AD-709095) Avail: NTIS CSCL 12/1

A new technique for constructing computational molecules for linear finite difference operators is developed. The basic approach is one of approximating a two dimensional surface with a geometrically consistent interpolating polynomial of degree four or five. The desired finite difference operator is then developed from the polynomial. The resulting molecules are geometrically consistent and may be used to solve boundary value problems without the use of fictitious points. Molecules for the biharmonic operator with various boundary conditions included are presented in the paper, as well as molecules representing the boundary conditions for shear and moment along the free edge of a plate. The integrity of the molecules presented is proven by comparison of solutions for flat plate bending problems by finite difference with exact solutions from the literature. Convergence plots for each problem are also presented. Author (TAB)

N70-41037*# Harvard Univ., Cambridge. Div. of Engineering and Applied Physics.
LEARNING WITH A PROBABILISTIC TEACHER
Ashok K. Agrawala May 1970 118 p refs Sponsored in part by AF and Army
(Grant NGL-22-007-143; Contract N00014-67-A-0298-0006)
(NASA-CR-113864; TR-611) Avail: NTIS CSCL 12A

A learning scheme, learning with a probabilistic teacher, is proposed in which a label is generated as a random variable from an appropriate probability density function. The scheme leads to a feasible solution to an unsupervised learning problem and assures the convergence of the estimate to the correct value. The average mean square error of the resulting estimate is twice the mean square error of the learning with a teacher estimate. The learning scheme can also be used to estimate the state of a Gauss-Markov sequence when the observation process has additive as well as multiplicative noise. Author

N70-41038*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Telecommunications Div.
THE PROBABILITY DENSITY FUNCTION OF A HARDWARE PERFORMANCE PARAMETER
C. E. Gilchriest and Man K. Tam (Tam Res. Associates) 1 Sep. 1970 82 p refs
(Contract NAS7-100)
(NASA-CR-113818; JPL-TM-33-439) Avail: NTIS CSCL 12B

A study of the probability density function of a hardware performance parameter delivered by a contractor to a specification is presented. Because sufficient data were not available to estimate this probability density function experimentally, it was necessary to derive a priori probability density functions from assumed axioms determined from an investigation of contractor motivation and behavior. From these axioms, the problem was formulated and solved in the form of a calculus of variations problem with integral and inequality constraints. Numerous examples are presented in which various strategies of contractor manipulation were used. The conclusions based on these examples are that incentive contracting is not an effective tool, and that close surveillance of the contractor is the most effective means for obtaining a hardware parameter to a specification. Author

N70-41068# Duke Univ., Durham, N.C. Dept. of Mathematics.
PARTIAL DIFFERENTIAL EQUATIONS Final Scientific Report, 1 Aug. 1967 - 15 Jan. 1969
J. Burlak 6 Jul. 1970 7 p
(Grant AF-AFOSR-435-67)
(AD-708984; AFOSR-70-1876TR) Avail: NTIS CSCL 12/1

The author discusses research performed in the area of Function Theory while under support of AFOSR. Author (TAB)

N70-41097# California Univ., Los Angeles. Dept. of Mathematics.
QUASIBOUNDED P-HARMONIC FUNCTIONS
Cecilia Yuen-Chiann Wang Jul. 1970 97 p refs
(Contract DA-ARO(D)-31-124-70-67)
(AD-709650; AROD-6929-41-M; TR-49) Avail: NTIS CSCL 12/1

Wieners P-compactification R^P of a Riemann surface, R, is introduced and a theory is developed of bounded and quasibounded solutions of the elliptic partial differential equation delta u = Pu with P = or > 0, P is not identically equal to 0, in terms of R^P, the P-harmonic boundary delta of R, and the P-singular point s. Author (TAB)

N70-41104# Institute for Advanced Study, Princeton, N.J.
QUASINILPOTENT LOCALLY CONVEX LIE ALGEBRAS AND THEIR TOPOLOGICAL GROUPS
N. Limic [1970] 69 p refs Sponsored by NSF
Avail: Issuing Activity

The properties of infinite-dimensional Lie algebras with the topological structure of a locally convex space are discussed with emphasis on generalizations of the nilpotent finite-dimensional Lie algebras. Existence conditions of topological groups which can be associated with infinite-dimensional Lie algebras are considered as well as representations of the obtained groups and the

corresponding Lie algebras. The Campbell-Hausdorff series is used for the group constructions. Locally convex Lie algebras are defined as being simultaneously continuous in both variables. Entities are made and the change of topologies is discussed. Some properties of quasi-nilpotent locally convex Lie algebras are summarized. The uniformly continuous, almost periodic functions on the constructed groups are used to determine the group algebra which is a normed*-algebra. The existence of a complete collection of irreducible, continuous unitary representations for the groups is proved. The relation of irreducible, continuous and unitary representations of the groups and representations of their Lie algebras on dense invariant domains is considered. J.M.

N70-41138# Hebrew Univ., Jerusalem (Israel). Inst. of Mathematics.

THEORIES OF COMPUTATION Final Report, 15 Jan. 1969 – 15 Jan. 1970

M. O. Rabin Jun. 1970 5 p refs

(Contract N00014-69-C-0192)

(AD-709413) Avail: NTIS CSCL 12/1

The work on Theories of Computation by Y. Bar-Hillel, E. Shamir, A. Levy, H. Gaifman, M. Rabin, B. Gabbay, M. Magidor and G. Moran is briefly reported. A bibliography of seventeen technical reports and articles containing the results of this effort is given. Author (TAB)

N70-41139*# Florida State Univ., Tallahassee. Dept. of Statistics.

BAYESIAN ANALYSIS FOR AN EXPONENTIAL SURVEILLANCE MODEL

Andres Petrasovits and Richard G. Cornell 1 Aug. 1970 14 p refs

(Grant NGR-10-004-029)

(NASA-CR-114233; TR-20) Avail: NTIS CSCL 12A

Bayesian estimation and design are considered for a dichotomous response surveillance model for defectives. The probability of a defective item after storage time t is assumed to be given by F(t) = 1 – exp (– lambda t), 0 less than t, lambda less than infinity. Surveillance is carried out by removing k lots from storage and observing the size (n sub i), storage time (t sub i) and number of defectives (r sub i) for each lot. The r sub i are assumed to be independently and binomially distributed with respective expectations n sub i F(t sub i). A prior gamma distribution is assumed to be available for lambda. The posterior distribution of lambda is derived as well as its moments, including the mean which is the Bayes estimate assuming quadratic loss. A formula for the corresponding Bayes risk is derived as are some recursive relationships to aid in computation. A design procedure is given for selecting surveillance times and sample sizes successively one lot at a time. Tables of optimum surveillance times and Bayes risks at these times as functions of the prior parameters and sample size are provided to help with this selection procedure. Author

N70-41140*# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.

DEVELOPMENTS OF BINARY DIGITS THAT ARE SUFFICIENTLY ACCURATE FOR SIMULATIONS AND OTHER USES Themis Signal Analysis Statistics Research Program

John E. Walsh and Grace J. Kelleher 31 Mar. 1970 16 p refs Supported in part by Mobil Res. and Develop. Corp.

(Grant NGR-44-007-028; Contract N00014-68-A-0515; Proj. Themis)

(NASA-CR-113880; AD-706361; THEMIS-SMU-TR-60) Avail: NTIS CSCL 12A

Desired is a set of very nearly random binary digits (very closely represent independent flips of an ideal coin with sides 0 and 1). Available is m X n array of approximately random binary digits obtained experimentally. No one of these digits is necessarily independent of any of the others but the level of dependence among rows is very small. A method is given for compounding these digits to obtain a smaller set that is much more nearly random. The randomness of a set of digits is measured by its maximum bias. A set is very nearly random if its maximum bias is very small. A maximum bias for compounded digits is determined from: The compounding method, the largest contribution to the maximum bias from within rows, and the largest contribution from the dependence among rows (very small). The maximum bias for a compounded set can be very small (even when the maximum bias for the initial set is quite large) but has a lower bound depending on the bias contribution from dependence among rows. One approach is oriented toward minimizing m for a given maximum bias for the compounded set, so that obtaining the initial set is simplified. Another approach is oriented toward having the number of compounded digits a reasonably large fraction of the number in the initial set. Author (TAB)

N70-41157*# Brown Univ., Providence, R.I. Div. of Applied Mathematics.

MATHEMATICAL PROGRAMMING AND THE CONTROL OF MARKOV CHAINS

H. J. Kushner and A. J. Kleinman May 1970 43 p refs

(Grants NGL-40-002-015; AF-AFOSR-0693-67A; NSF GK-2788)

(NASA-CR-113904; TR-70-2) Avail: NTIS CSCL 12A

Linear programming versions of some control problems on Markov chains are derived and are studied under conditions occurring in typical problems which arise by discretizing continuous time and state systems, or in discrete state systems. Control interpretations of the dual variables and simplex multipliers are given. The formulation allows the treatment of state space-like constraints which cannot be handled conveniently with dynamic programming. The relation between dynamic programming on Markov chains and the deterministic discrete maximum principle is explored, and some insight is obtained into the problem of singular stochastic controls (with respect to a stochastic maximum principle). Author

N70-41160*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DEPRIVATION OF NEWTONIAN-TYPE INTEGRATION COEFFICIENTS AND SOME APPLICATIONS TO ORBIT CALCULATIONS

C. E. Velez and J. L. Maury Washington Oct. 1970 52 p refs

(NASA-TN-D-5958; G-979) Avail: NTIS CSCL 12A

Recursive relations for the computation of coefficients defining a general class of Newtonian-type integration and quadrature formulas are developed using finite difference operator techniques. These relations are expressed as functions of parameters in such a way that by specifying certain integral values, the well-known recursive relations for the coefficients are easily obtained. Some applications of the formulas available in this class are also presented. The applications discussed include starting techniques for orbital integration and multirevolution integration. Finally, a description of a computer program used to generate these coefficients is presented, and tables of coefficients defining the more commonly used methods are given. Author

N70-41165# California Univ., Irvine.

SPACES OF H-STRUCTURES

George McCarty [1970] 15 p refs

(Grant NSF GP-7913)

Avail: Issuing Activity

A study of the homotopy groups in all dimensions of the space of H-structures on a given CW complex Y is initiated. Calculations are offered for some of these groups in ca e Y is a finite Postnikov system or a sphere, and a representation of these groups is introduced into a defined homomorphism, which in several senses generalizes the Samuelson product. Author

N70-41171# Florida Univ., Gainesville.
DISPERSAL IN COMPACT SEMIMODULES
Alexander Doniphan Wallace [1970] 10 p refs
Avail: NTIS

The objective is to establish for semimodules certain propositions proved for topological semirings and semigroups. The compactness property is used to establish the propositions supported by proofs of lemmas and theorems. E.H.W.

N70-41213# RAND Corp., Santa Monica, Calif.
DUALITY IN NONLINEAR PROGRAMMING: A SIMPLIFIED APPLICATIONS-ORIENTED DEVELOPMENT
A. M. Geoffrion Jun. 1970 83 p refs
(Contract F44620-67-C-0045)
(AD-709184; RM-6314-PR) Avail: NTIS CSCL 12/2

A simpler, more versatile, and more general approach is presented to the computational solution of complex practical optimization problems of nonlinear programming through their duals. Duality theory gives prices for scarce resources, and certain planning problems are more easily solved by passing to an equivalent dual problem. However, the number of applications so far is small compared to the number of theoretical papers. This study avoids differential calculus, minimax theory, and the conjugate functions or fixed-point theorems employed by most studies in duality theory. Instead, it uses only assumptions that are likely to be verifiable, and relies on the relatively elementary theory of convexity and the concept of a perturbation function--the optimal value of a program as a function of perturbations of its right-hand side. The approach gives useful geometric and mathematical insights and is closely interwoven with optimality theory. Author (TAB)

N70-41216*# Brown Univ., Providence, R.I. Div. of Applied Mathematics.
ALMOST PERIODIC BEHAVIOR OF SOLUTIONS OF A NONLINEAR VOLTERRA SYSTEM, 2
R. K. Miller [1969] 23 p refs
(Grants NGL-40-002-015; AF-AFOSR-693-67B)
(NASA-CR-113921) Avail: NTIS CSCL 12A

Forced almost periodic oscillations in a nonlinear system of two Volterra integral equations are considered. It is shown that the oscillatory solution is Lyapunov stable under small perturbations in the coefficients of the equation. It is also shown that whenever the coefficients are quasiperiodic and analytic, the almost periodic oscillation is in the same class. Author

N70-41241*# Florida State Univ., Tallahassee. Dept. of Statistics.
APPROXIMATIONS TO THE BAYES ESTIMATE FOR A QUANTAL ASSAY WITH SIMPLE EXPONENTIAL TOLERANCE DISTRIBUTION
Andres Petrasovits (Can. Dept. of Agriculture) and Richard G. Cornell 1 Sep. 1970 15 p refs
(Grant NGR-10-004-029)
(NASA-CR-113862; TR-21) Avail: NTIS CSCL 12A

Approximations to the computationally cumbersome Bayes estimate of the parameter lambda in the exponential tolerance distribution $F(d) = 1-\exp(-\text{lambda } d)$, $d \geq 0$, are developed for dichotomous response quantal assays. A gamma prior distribution and a quadratic loss function for lambda and a binomial distribution of positives at each dose d for fixed lambda are assumed. The first approximation is for a single-dose assay, is easily computed and has average risk only slightly larger than the Bayes risk for small samples. The selection of d and n are considered when this approximation is to be used as an estimate of lambda. The second approximation is a modification of the first, is somewhat more difficult to compute than the first and retains the relatively small average risk of the first for small samples but, unlike the first, is a consistent estimate of lambda. The third approximation is an extension of the first to an assay with several doses. Author

N70-41243*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
ON THE UNIFORM ASYMPTOTIC STABILITY OF FUNCTIONAL DIFFERENTIAL EQUATIONS OF THE NEUTRAL TYPE
J. K. Hale and A. F. Ize [1970] 14 p refs
(Grants NGL-40-002-015; AF-AFOSR-693-67; AF-AFOSR-693-67B)
(NASA-CR-113889) Avail: NTIS CSCL 12A

The relationship between the uniform asymptotic stability of a linear neutral differential equation and a perturbed equation is considered. Limiting conditions are given for the solutions of various equations, and theorems are proven to bring about the relationship. D.L.G.

N70-41254# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
EXISTENCE AND SPECIFIC RESEARCH FOR ONE CLASS OF WEAK SINGULAR INTEGRAL EQUATIONS [EXISTENZ- UND EINDEUTIGKEITSUNTERSUCHUNGEN FUER EINE KLASSE SCHWACH SINGULAERER INTEGRALGLEICHUNGEN ERSTER ART]
Manfred Breger (Ph.D. Thesis) 1968 78 p refs In GERMAN
Avail: NTIS

The solution of one class of weak singular integral equations is discussed. Mathematical formulas, mathematical models, and procedures for solving integral equations are presented. Transl. by P.N.F.

N70-41256# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
NUMERICAL PROCEDURES FOR CONVERSION OF CONVOLUTION TRANSFORMS [NUMERISCHE VERFAHREN ZUR UMKEHRUNG VON FALTUNGSTRANSFORMATIONEN]
Detlef Krueger (Ph.D. Thesis) 1968 104 p refs In GERMAN
Avail: NTIS

Numerical procedures for the conversion of convolution transforms are discussed. The application of these procedures to the solution of specific problems is described. Mathematical models, tables, and graphs are provided. Transl. by P.N.F.

N70-41258# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.
CONCERNING THE SYNTHESIS OF LINEAR TIME-VARIABLE SYSTEMS [UEBER DIE SYNTHESE LINEARER ZEITVARIABLER SYSTEME]
Eckhard Freund (Ph.D. Thesis) 1968 101 p refs In GERMAN
Avail: NTIS

The synthesis of linear time-variable systems with general operators is described and the use is explained. The repeating operators become, by the method described, time-variable frequency response and the weighting factors become a scalar differential equation. The representation in conditional characters and the accompanying calculations are presented. Transl. by P.N.F.

N70-41263# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
COMPUTER TIME COMPARISON OF POINT AND BLOCK SUCCESSIVE OVER-RELAXATION
J. T. Pearson and B. Kaplan 1970 13 p refs
(AD-709186; AFIT-TR-70-6) Avail: NTIS CSCL 9/2

The paper presents the results of numerical experiments that were conducted to compare point and block iterative methods with respect to the relative computer time consumed and the number of iterations required for convergence. Although the latter

consistently required a smaller number of iterations for convergence, the experimental results indicate that this does not necessarily imply smaller computation time for the overall calculation.
Author (TAB)

N70-41279# Watervliet Arsenal, N.Y. Benet R and E Labs.
A SIMPLE STOCHASTIC REPLACEMENT MODEL
Royce W. Soanes, Jr. Jun. 1970 49 p ref
(AD-708871; WVT-7040) Avail: NTIS CSCL 15/5

The report considers the following problem: Given the failure distribution of an article, a replacement time r, the cost of replacement before failure and the (larger) cost of replacement after failure, find the expected cost per unit service time of using up n articles. An asymptotic formula for cost per unit service time is derived containing second order terms in n. The minimization of cost per unit service time with respect to r is the main objective of the analysis.
Author (TAB)

N70-41285# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
CONSTRUCTIVE SOLUTION FOR INITIAL BOUNDARY VALUE PROBLEMS OF PARABOLIC DIFFERENTIAL EQUATIONS IN A PLANE [KONSTRUKTIVE LOESUNG VON ANFANGSRANDWERTAUFGABEN PARABOLISCHER DIFFERENTIALGLEICHUNGEN IN DER EBENE]
Hansuwe Lange (Ph.D. Thesis) 1968 52 p refs In GERMAN
Avail: NTIS

Boundary value problems of heat transfer equations are subjected to elementary coordinate transformations so that problems with time fluctuating boundaries are transformed into problems with constant boundaries without changing most of the equations involved. Volterra integral equations are obtained for three boundary value problems and are then solved by iteration. Differentiation of solutions is provided by similar methods as applied for elliptical differential equations containing a primary potential equation.
Transl. by G.G.

N70-41295*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ON THE EQUIVALENCE OF OPTIMAL CONTROL PROBLEMS AND THE TRANSFORMATION OF OPTIMAL CONTROL PROBLEMS WITH COMPACT CONTROL REGIONS INTO LAGRANGE PROBLEMS
Stephen Kent Park (Ph.D. Thesis—N.C. State Univ., Raleigh) 1970 74 p refs
(Grant NGL-34-002-032)
(NASA-TM-X-66347) Avail: NTIS CSCL 12A

Several natural types of equivalence are defined for a set of optimization problems. Using these concepts of equivalence, a method is described by which an optimal control problem with a compact control region U can be transformed into an equivalent optimal control problem with an arbitrary control region Z. This method assumes the existence of a function psi which maps Z onto U and satisfies certain continuity requirements. It is shown that when U is convex the existence of this function is guaranteed and that when U is, in addition, a polyhedron various representations for psi are given. The particular case where Z is all of euclidean p-space, for some positive integer p, is considered in some detail. It is shown that when U is a convex body the optimal control problem is equivalent to (i.e., may be transformed into) an optimal control problem in which the control functions are unconstrained. Furthermore, when U is a polyhedron it is shown that the optimal control problem is equivalent to a classical Lagrange problem. This latter result provides, as an application, a proof of the Pontryagin maximum principle based upon known necessary conditions in the calculus of variations.
Author

N70-41313# Technische Univ., Berlin (West Germany).
ON THE APPLICATION OF REGRESSION ANALYSIS FOR THE CHARACTER RECOGNITION PROBLEM [UEBER DIE ANWENDUNG DER REGRESSIONSANALYSE AUF DAS ZEICHENERKENNUNGSPROBLEM]
Juergen Schuermann (Ph.D. Thesis) 1968 113 p refs In GERMAN
Avail: NTIS

Automatic recognition of symbols by classification according to their physical properties relies on statistical regression analysis. A probability formula is developed that considers the apparent class association as a function of effective variables in a classification model. Sequential multiple linear regression simplifies the calculation to vectorial values so that each of the k differing classes contains the basic vector of a k-dimensional orthogonal basic vector system. The optimal classificator is approximated and adjusted to a defined recognition problem by a brief adaptation process.
Transl. by G.G.

N70-41314# Technische Univ., Berlin (West Germany).
ON COMPLEX SYSTEMS OF PARTIAL LINEAR DIFFERENTIAL EQUATIONS OF FIRST ORDER [UEBER ZUSAMMENGESETZTE SYSTEME PARTIELLER LINEARER DIFFERENTIALGLEICHUNGEN ERSTER ORDNUNG]
Christian Vidic (Ph.D. Thesis) 1968 51 p refs In GERMAN
Avail: NTIS

Real functions of two independent variables x and y are used to form a linear system of n partial differential equations that contains their partial derivatives towards x resp. y. Existence and definition theorems for the complex systems with various starting and boundary conditions are developed for the case that n = 3. Integral equations are formed equivalent to the given differential equation system and fitted to the problem conditions. Finally, a connection between elliptical differential equations of the second order and complex systems with three unknowns is obtained: the differential equation can always be written as a complex system of the third order; but as an elliptical system of the second order only if the coefficient of the sought function disappears.
Transl. by G.G.

N70-41355# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
ON THE GENERALIZATION OF THE INCIDENCE MATRIX CONCEPT [UEBER EINE VERALLGEMEINERUNG DES BEGRIFFS DER INZIDENZMATRIX]
Dieter Naundorf (Ph.D. Thesis) 1968 94 p refs In GERMAN
Avail: NTIS

The properties of products from incidence matrices are developed for special combinatorial systems. Theoretical mass operations for (0,1)-vectors are explained and the relationships between incidence matrix properties and some combinatorial mathematical aspects are obtained. An example calculation is given for the (0,1)-matrix 7(n,k,l) which consists of various (0,1)-vectors with k ones and n zeroes. Special partial matrices of 7(n,k,l) r-selections are defined and simple solutions are obtained that consider the properties of fraction summing vectors in corresponding incidence matrices of differing orders. Necessary conditions for the existence of r-selections and incidence matrices of the Steiner system are outlined.
Transl. by G.G.

N70-41464*# Stanford Univ., Calif.
LECTURES ON CONTROLLABILITY AND OBSERVABILITY
R. E. Kalman 1968 149 p refs Presented at Centro Intern. Mat. Estivo Seminar on Controllability and Observability, Bologna, 1–9 Jul. 1968
(Grant NGR-05-020-073; Contract AF 49(638)-1440)
(NASA-CR-113869) Avail: NTIS CSCL 12A

Interaction between the concepts of controllability and observability, and the study of structure of dynamical systems, such as formulation and solution of the problem of realization, canonical forms, decomposition of systems, and uniqueness of minimal realization are discussed. Lecture topics include classical and modern dynamical systems, standardization of definitions and classical results, definition of states via Nerode equivalence classes, modules induced by linear input/output maps, cyclicity and related questions, transfer functions, construction and abstract construction of realizations, theory of partial realizations, and the general theory of observability. J.M.

N70-41490# State Univ. of New York, Albany.
A NOTE ON FK SPACES WHICH ARE CONSERVATIVE SUMMABILITY FIELDS
H. I. Brown and H. H. Stratton [1969] 17 p refs Submitted for publication
(Grants NSF GP-12017; NSF GP-8502)
Avail: Issuing Activity

Conservative summability fields with real number sequences and subsets of bounded, convergent, and null sequences are examined. An infinite matrix of real numbers was represented in a defined set. J.A.M.

N70-41491# State Univ. of New York, Albany.
STRONG LAWS FOR RULED SUMS
Leonard E. Baum (Inst. for Defense Analysis), M. Katz, and H. H. Stratton [1970] 12 p refs
(Grants NSF GP-8194; NSF GP-8502)
Avail: Issuing Activity

A comparison of strong properties for S sub (n) and S sub n is presented. It is shown that for symmetric X sub k, and most well behaved sequences, a set of a sub n, the limit (S sub n/a sub n) = or < the limit of (S sub (n)/a sub n) = or < the limit of (S sub ((n))/a sub n) for all rules epsilon of a set of rules; if (n) = the set 1,2...,n, then S sub (n) is denoted by S sub n, and if (n) intersection (m) = the null set for n not = m, then ( ) is denoted by (( )). Laws of the iterated log type, strong convergence laws, and convergence rates are also compared. Analogs of the convergence rate theorems for S sub n are shown for S sub (n). J.M.

N70-41510# Technische Univ., Berlin (West Germany). Fakultaet fuer Elektrotechnik.
A MULTIPLE STEP TOPOLOGICAL METHOD FOR MINIMIZATION OF SWITCHING FUNCTIONS [EIN MEHRSTUFIGES TAFELVERFAHREN ZUR MINIMISIERUNG VON SCHALTFUNKTIONEN]
Eberhard Wildenhain (Ph.D. Thesis) 1968 113 p refs In GERMAN
Avail: NTIS

The optimization formula for a given switching function is determined by reducing the problem of n variables to several equal problems with only m variables (m less than n). Separation of the switching function into a system of sub-functions with m variables precedes the minimization by partial prime implicants in several steps. The number m is flexible so that the switching function with n variables can be reduced to subfunctions with numerous variables. Prime implicants are speedily determined if m = 4 is chosen and the full conjunctions in the Karnaugh tables are used. Transl. by G.G.

N70-41519# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mathematics.
INFERENCE IN STOCHASTIC PROCESSES Final Report
M. M. Rao Jul 1970 8 p
(Grant AF-AFOSR-1647-69)
(AD-709223; AFOSR-70-1941TR) Avail: NTIS CSCL 12/1

The investigation was designed to prepare a monograph on certain mathematical aspects of the inference theory of stochastic processes, the principal components of which are substantially completed. These include substantive treatments of the foundations of inference theory, i.e., the projective limits of probability spaces, of conditional probability distributions and expectations, which occupy a central position in the analysis of essentially all the problems of inference, some new or simplified proofs of the standard theory of martingales together with a demonstration of the equivalence of the martingale convergence and the Andersen-Jessen theory, of stochastic difference and differential equations in both the physical and social sciences, of Gaussian processes, and of hypothesis testing, parametric estimation, and prediction, as the latter three topics relate to inference theory. Author (TAB)

N70-41591# Joint Publications Research Service, Washington, D.C.
DIFFERENTIAL GAME THEORY
14 Sep. 1970 15 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 193, no. 2, 1970 p 284–287; 294–297
(JPRS-51364) Avail: NTIS

CONTENTS:
1. DIFFERENTIAL APPROACH GAME N. N. Krasovskiy p 1–6 refs (See N70-41592 23-19)
2. DIFFERENTIAL GAMES WITH RESTRICTIONS ON THE PHASE STATES A. I. Subbotin p 7–12 refs (See N70-41593 23-19)

N70-41592# Joint Publications Research Service, Washington, D.C.
DIFFERENTIAL APPROACH GAME
N. N. Krasovskiy *In its* Differential Game Theory 14 Sep. 1970 p 1–6 refs (See N70-41591 23-19)
Avail: NTIS

A differential approach game with a given set is investigated when the controlled system is described by a vector differential equation, and the purpose of the first player is to bring the point to the closed set no later than some fixed time. The problem of the second player is to prevent this. The initial position of the game is given, and the strategies are defined by a system of sets. The strategy which insures the approach of the point to the target is found. F.O.S.

N70-41593# Joint Publications Research Service, Washington, D.C.
DIFFERENTIAL GAMES WITH RESTRICTIONS ON THE PHASE STATES
A. I. Subbotin *In its* Differential Game Theory 14 Sep. 1970 p 7–12 refs (See N70-41591 23-19)
Avail: NTIS

A differential game in which the payoff is time before the phase point encounters a set is studied. Statements of the game problems are presented, and the structure of the optimal approximating strategies is described. The equation describing the motions of the system are given. The minimax strategy is formulated, in which all possible approximating strategies of the first player are contained, and for any integrable function the programmed strategy of the second player is found. F.O.S.

N70-41699# California Univ., Riverside. Dept. of Mathematics.
APPLICATION OF LAPLACE OPERATORS Final Status Report, 1 Jul. 1966–31 Jul. 1969
Victor L. Shapiro 6 Jan. 1970 9 p
(Grant AF-AFOSR-694-66)

(AD-709716; AFOSR-70-2028TR) Avail: NTIS CSCL 12/1

The bulk of the report is concerned with a description of the following two papers: (1) Sets of uniqueness for the vibrating string problem (published in the Transactions of the American Mathematical Society); and, (2) Removable sets for pointwise solutions of the Cauchy-Riemann equations (to be published in the Annals of Mathematics). These two papers represent one of the important concepts developed by the principal investigator during the period of the grant; namely, by using the Laplace and generalized Laplace operators in conjunction with recent sophisticated developments in the theory of multiple trigonometric series, fundamental new results can be achieved in the theory of partial differential equations. Author (TAB)

N70-41700# RAND Corp., Santa Monica, Calif.
A CAUCHY SYSTEM FOR A CLASS OF NONLINEAR FREDHOLM INTEGRAL EQUATIONS
J. Casti, R. Kalaba, and S. Ueno Feb. 1970 23 p refs
(Contract F44620-67-C-0045)
(AD-709733; RM-6186-PR) Avail: NTIS CSCL 12/1

The report discusses the derivation of a Cauchy system whose numerical solution is equivalent to that of a nonlinear integral equation. The memorandum treats a nonlinear integral equation of Hammerstein type which arises in problems of mathematical physics and biology. A Cauchy problem is derived for the solution of the equation and a proof is given to show that the solution of the Cauchy problem does satisfy the original equation. Author (TAB)

N70-41719# California Univ., Berkeley. Space Sciences Lab.
A NEW METHOD FOR ESTABLISHING THE EXISTENCE OF ANALYTIC FUNCTIONS. 1: THE SIEGAL NORMAL FORM THEOREM
Stephen P. Diliberto Jul. 1970 26 p refs *Its* Space Sci. Lab. Ser. 11, Issue 56
(Contract N00014-69-A-1024)
(AD-709401) Avail: NTIS CSCL 12/1

The paper contains the first of a series of applications of a new method, developed by the author, for establishing the existence of an analytic function by making successive changes of variables. One establishes Siegels theorem that for good or generic small divisors, nonlinear ordinary differential equations may be linearized. Author (TAB)

N70-41724# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.
A TABLE OF THE COMPLETE ELLIPTIC INTEGRAL OF THE FIRST KIND FOR COMPLEX VALUES OF THE MODULUS. 3: AUXILIARY TABLES Final Report
Henry E. Fettis and James C. Caslin May 1970 171 p refs
(AD-709681; ARL-70-0081) Avail: NTIS CSCL 12/1

This report contains tables of the following: F(R, theta) = K(R, theta) − (1 + (2/Pi)K' (R, theta) (ln (4/Rho) − 1 + i phi)) and F'(R,theta) = K'(R, theta) − (1 + (2/Pi)K(R, theta) (Ln(4/R) + 1 − i theta)) together with K, K' and their second central differences. In the above, K(R) is the complete elliptic integral of the first kind with modulus R = Re sup (i theta) and K'(k) = K(k') (k' identical with the square root of (1 − k squared) = rho e sup (−i phi)). These functions have the property that they are interpolatable in the regions tabulated, namely R between .7 and 1, theta between 0 and 10 degrees and R between 0 and 35, theta between 0 and 90 degrees. Author (TAB)

N70-41731# California Univ., Berkeley.
ON THE WAVE EQUATION IN A MULTI-DIMENSIONAL CORNER
I. A. K. Kupka and S. Osher 1970 19 p refs
(Contract N00014-69-0200-1017; Grant NSF GP-8007)
(AD-709568) Avail: NTIS CSCL 12/1

The paper describes the special case of the wave equation in the region x1,... xm, t = or > 0 with boundary conditions involving u and its normal derivative at each face. Existence, uniqueness, and continuous dependence of the solution on the inhomogeneous term are proven. A closed form for its Fourier-Laplace transform is obtained. TAB

N70-41757# Texas Univ., Austin. Computation Center.
A PRIORI METHODS FOR THE DETERMINATION OF THE OPTIMUM RELAXATION FACTOR FOR THE SUCCESSIVE OVERRELAXATION METHOD Interim Technical Report
Charles H. Warlick and David M. Young May 1970 23 p refs
(Grants DA-ARO(D)-31-124-G721; NSF GP-5253)
(AD-709708; AROD-3772-60-M; ITR-25) Avail: NTIS CSCL 12/1

The paper is concerned with methods for estimating the optimum relaxation factor for use with the successive overrelaxation method for solving the linear system Au = b. Special attention is given to linear systems arising from the solution by finite difference methods of boundary value problems corresponding to separable elliptic partial differential equations. Two classes of methods are considered: one leads to exact results and is based on the solution of an eigenvalue problem associated with an ordinary difference equation; the other leads to approximate results and is based on the solution of an eigenvalue problem involving an ordinary differential equation. An example involving the equation (u sub xx) + (k/y)(u sub y) + (u sub yy) = 0 is treated in detail. Author (TAB)

N70-41790*# LeMoyne Coll., Syracuse, N.Y.
DISSIPATIVE PERIODIC PROCESSES
J. E. Billotti and J. P. LaSalle (Brown Univ.) [1970] 22 p refs Prepared in cooperation with Brown Univ.
(Grant NGL-40-002-015; Contract DA-31-124-ARO(D)-270; Grant AF-AFOSR-0693-67A)
(NASA-CR-113865) Avail: NTIS CSCL 12A

A general theory of dissipative periodic systems is developed for application to dynamic systems defined by partial differential equations, functional differential equations, systems arising in the theory of elasticity, and similar cases. The basic theory of dissipative periodic process on Banach spaces is developed, and application to retarded functional differential equations is discussed. Two sufficient conditions for dissipativeness are given in terms of Liapunov functions. N.E.N.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N70-40483# International Geophysical Year World Data Center A, Washington, D.C.
HIGH ALTITUDE METEOROLOGICAL DATA, VOLUME 6, NO. 2
Asheville, N.C. Natl. Climatic Center Feb. 1969 186 p
Avail: SOD $3.00

Wind and temperature measurements from all available meteorological sounding rocket firings are presented, along with computed values for pressure, density, and speed of sound. Local radiosonde observations nearest the time of firing are included. Author

N70-40501# Texas Univ., Austin. Atmospheric Science Group.
THE SPECTRUM OF ATMOSPHERIC TURBULENCE FOR HORIZONTAL VELOCITY COMPONENTS IN THE SURFACE BOUNDARY LAYER OF A SEA BREEZE CIRCULATION
James A. Almazan May 1970 223 p refs
(Contract DA-29-040-AMC-1802; Grants NSF GA-367X1; NSF GA-16167)
(AD-708876; Rept-22) Avail: NTIS CSCL 4/1

Spectral and cross-spectral analyses of horizontal wind components from data collected by the author on an experiment at the upper Texas coast are presented. The wind data are from instruments mounted at 1, 6.7, and 27 meter levels on two towers. One tower was 90 meters from the coastline and the other approximately 4.8 kilometers inland on a line perpendicular to the coastline. The data were recorded simultaneously at both towers on analog tape and digitized electronically. Data samples analyzed are from a continuous 14-hour experiment which covered the land and sea breeze regimes of the sea breeze phenomenon, including the transition period. The sampling periods are approximately 17, 67, and 133 minutes. Author (TAB)

N70-40502 National Lending Library for Science and Technology, Boston Spa (England).
SOLAR ACTIVITY AND THUNDERSTORM ACTIVITY
Ja. I. Linter et al 29 May 1970 12 p refs Transl. into ENGLISH from Glav. Geof. Obs., T. vyp. (Leningrad), v. 242, 1969 p 104–112
(NLL-M-9154-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Studies on the relationship between solar activity and thunderstorms show no parallel between the 11 year variations of a number of thunderstorms and solar activity. The thunderstorm activity is shown to have two maxima and minima, the maxima occurring about 1.5 to 2 years before and after a minimum in solar activity, and the minima coinciding with either a solar maximum or sunspot minimum. Meteorological data show latitudinal variations in the quasi-periodic variation of thunderstorm activity. R.B.

N70-40506# Army Electronics Command, Fort Monmouth, N.J. Atmospheric Sciences Lab.
METHOD OF DETERMINING HAIL COVERAGE WITH AN AIRBORNE INFRARED THERMOMETER
Albert R. Tebo May 1970 14 p refs
(AD-708548; ECOM-3284) Avail: NTIS CSCL 4/2

The fraction of a given area of ground that is covered by hail can be determined by using an airborne infrared thermometer. If the ambient ground temperature and the hail-covered ground temperature are measured with the same thermometer, and the surface of the hail is assumed to be at a temperature of 0C, then a simplified equation enables the determination of fractional coverage with a maximum error of 0.03 in all expected temperature regimes. Variations in the wavelength passband of the radiation thermometer and in the emissances (emissivities) of the surfaces are taken into account in the equation. Author (TAB)

N70-40548# Texas A&M Research Foundation, College Station.
PREDICTION OF ENVIRONMENTAL PARAMETERS Annual Report, 20 Sep. 1968 – 20 Sep. 1969
K. C. Brundidge, R. A. Clark, W. H. Clayton, P. Das, and D. Juric Jun. 1970 103 p refs
(Contract DAAB07-68-C-0073)
(AD-708569; A/M-REF-69-15A; ECOM-0073-3) Avail: NTIS CSCL 4/2

The material contained herein reviews research efforts during the second year on Project Themis at Texas A and M University. These efforts have been concentrated in five primary research areas: analysis and prediction of atmospheric structure through use of dual frequency radars and associated ground facilities; cumulus cloud dynamics; analog modeling of the frictional boundary layer; design of a facility for direct measurement of Reynolds Stresses; and modification of cloud systems moving over areas of different water temperatures. The latter study, which was initially undertaken primarily as a dissertation subject, has been expanded and is now cooperatively sponsored by the Environmental Sciences Services Administration. The activities under all of the research subdivisions noted above are reviewed separately within. Author (TAB)

N70-40563 National Lending Library for Science and Technology, Boston Spa (England).
ON THE FUNCTIONAL RELATIONSHIP BETWEEN STATISTICAL PARAMETERS OF TEMPERATURE AND HUMIDITY
E. E. Zukovskij 14 May 1970 7 p refs Transl. into ENGLISH from Tr. Agrofiz. Nauchn.-Issled. Atel Inst., Agron. Fiz. (Leningrad), no. 20, 1969 p 46–54
(NLL-M-9113-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Linear equations are obtained connecting the statistical characteristics of three random nonstationary processes: air temperature, relative humidity, and water vapor pressure. It is shown that the mutual correlation functions of temperature with relative humidity and of vapor pressure with temperature are very different; whereas the values of the first are small, the values of the second may reach unity. This conclusion is of general value independently of the climatological geographical conditions. In the specific conditions of the Leningrad Hydrometeorological Station, when the correlation between the relative humidity and the temperature is poor, and tau is small, very substantial correlation is observed between the vapor pressure and the temperature, reaching 0.6 to 0.9. Author

N70-40608# Alaska Univ., College. Geophysical Inst.
ICE FOG: LOW TEMPERATURE AIR POLLUTION
Carl S. Benson Jun. 1970 67 p refs
(Contracts DA-ENG-11-190-61-G3; DA-AMC-27-021-64-G5)
(AD-708544; CRREL-RR-121) Avail: NTIS CSCL 4/2

The Stanford Research Institute carried on a study of ice fog at Eielson Air Force Base between 1951 and 1955. Their report (Robinson et al., 1955) is the most comprehensive available on the subject, yet several areas of research still need attention. The study began with three general objectives: (1) Genesis and morphology of ice crystal forms in ice fogs. (2) Vertical distribution of temperature and crystal forms in ice fogs. (3) Meso-micro-meteorological conditions associated with ice fog development and dissipation. Observations were made during the winters of 1961-62 and 1962-63. Author (TAB)

N70-40635 National Lending Library for Science and Technology, Boston Spa (England).
A NEW WAY OF REALISING DISCRIMINANT AND REGRESSION SCHEMES
M. G. Ter 29 May 1970 13 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 7, 1969 p 44–45
(NLL-M-9132-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A scheme for precipitation forecasting based on discriminant analysis is described. The scheme is stabilized by including three months from each season in the sample to lengthen the archive of forecasting data. The dynamics of the weather formation process are taken into account by using the coefficients of expansion in the temperature field for the three months preceding the forecast month. The optimum number of predictors are determined and nonparametric methods of discriminant analysis are used. R.B.

N70-40647 National Lending Library for Science and Technology, Boston Spa (England).
THE EFFECT OF WEATHER CONDITIONS ON THE DISTRIBUTION OF MINIMUM AIR TEMPERATURE
L. G. Vasileva 29 May 1970 14 p refs Transl. into ENGLISH from Tr. Glav. Geof. Obs. (Leningrad), no. 248, 1969 p 119-127 (NLL-M-9064-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Pairs of stations, not more than 80 to 100 km apart, were selected for the study, the reference station's being situated on a level open place with normal inversion conditions and with no towns or water areas in the neighborhood, and the second station's being under the influence of various special features of the underlying surface, such as relief or vicinity of water areas. Data are analyzed for the month of July averaged over three year periods. The nights were divided according to four main weather groups, and the minimum temperatures were averaged for each group. The result gives the mean variation of the air temperature minimum and its extreme values for a number of regions in the Soviet Union depending on individual characteristics of the locality of the stations in different types of weather. The most marked temperature variations are observed on cloudless nights with little wind and low humidity. P.A.B.

N70-40693# Naval Postgraduate School, Monterey, Calif.
CORRELATION OF SEA SURFACE TEMPERATURE WITH CLOUD PATTERNS OFF THE WEST COAST OF NORTH AMERICA DURING THE UPWELLING SEASON
Anthony Leo Gerst (M.S. Thesis) Dec. 1969 120 p refs
(AD-709066) Avail: NTIS CSCL 8/3

The possibility of a correlation between sea surface temperature (SST) and cloud patterns was investigated using cloud photos from the satellites NIMBUS II (1967) and ESSA VI (1968). Five types of correlation were found to exist: the correlation between stratus and the California Current amd upwelling areas in a warm air mass, between clearing and the California Current and upwelling areas in a cold air mass, between stratus and the upwelling areas under favorable conditions, between frontal clouds and warm tongues of surface water, and between vortices and cold tongues of surface water. A sixth type correlation was found between the surface isobaric pattern and the orientation of cold and warm tongues of surface water. Finally, the divergence of the surface isobars was found not to correlate with the stratus pattern. An awareness of the physical conditions off the coast was vital to seeing and understanding these correlations. A model SST analysis, using the six types of correlation observed, represented the actual SST analysis significantly better than the historical SST analysis. Author (TAB)

N70-40722# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 236 11 Sep. 1970 p 1-16 refs (See N70-40721 23-34)
Avail: NTIS

Synoptic statistical analysis and forecasting of high level frontal zones, air temperature, and vertical air currents are examined, as well as hydrodynamic theory of atmospheric circulation. A book is reviewed on radar characteristics of the sea surface and hydrometeorological formations in centimeter and millimeter wavelengths. Articles are discussed on radiation processes and satellite meteorology, boundary layer physics, physical-statistical studies of atmospheric circulation, and brightness properties of cloud-atmosphere system. Surface and aircraft traps for aerosol collection are described, along with an electron spectrophotometer. Abstracts on various meteorological literature are also included. J.A.M.

N70-40736# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD SPECIALISTS' MEETING ON THE AERODYNAMICS OF ATMOSPHERIC SHEAR FLOWS Technical Evaluation Report
J. E. Cermak and B. W. Marschner May 1970 9 p refs Conf. held at Munich, 15-17 Sep. 1970
(AGARD-AR-24-70) Avail: NTIS

The purpose of this meeting was to coordinate the efforts of atmospheric scientists and aeronautical engineers. The common language of fluid dynamics was used in attacking the basic and applied problems of atmospheric motion near the earth's surface. One of the main recommendations is for a coordinated field and laboratory study to verify similarity between wind tunnel generated flow and the corresponding atmospheric shear flow. A list of the papers presented is included, with brief comments on their content and value. Author

N70-40766*# Center for the Environment and Man, Inc., Hartford, Conn.
CLOUD AND SYNOPTIC PARAMETERS ASSOCIATED WITH CLEAR AIR TURBULENCE Final Report
John T. Ball Aug. 1970 72 p refs
(Contract NAS12-699)
(NASA-111778; CEM-7496-413) Avail: NTIS CSCL 04B

Research was initiated to determine relationships between clear air turbulence (CAT) in the stratosphere and upper troposphere, and meteorological variables, circulation features and cloud characteristics. For this purpose, a total of 372 cases of CAT occurrence and nonoccurrence were analyzed using aircraft instrumented reports of CAT in the 45,000-70,000 ft layer as obtained by the U.S. Air Force in Project HICAT from 1966 through 1968. Light to moderate or more intense CAT occurs frequently when the vertical temperature profile about the level of interest is irregular and includes both strong inversions and layers in which the temperature decreases rapidly with height. Consistent numerical relationships were determined for a number of meteorological variables describing this condition. Implementation of these results for the development of CAT detection instrumentation is discussed. The analysis of circulation features showed that significant stratospheric CAT was associated with large horizontal temperature gradients at upper-level surfaces. Cloud characteristics associated with significant turbulence were cirrus bands and streaks, a well-defined frontal cloud band, transverse wave clouds, and cumulonimbus clouds. Author

N70-40792# Chicago Univ., Ill. Dept. of Geophysical Sciences.
AIRCRAFT, SPACECRAFT, SATELLITE, AND RADAR OBSERVATIONS OF HURRICANE GLADYS, 1968
Tetsuya T. Fujita, R. Cecil Gentry (Natl. Hurricane Res. Lab.), and Robert C. Sheets (Natl. Hurricane Res. Lab.) May 1970 27 p refs
(Grants ESSA-E22-69-70(G); ESSA-E22-41-69)
(SMRP-RP-83) Avail: Issuing Activity

Hurricane Gladys, 17 October 1968, is studied with data collected by the Apollo 7 manned spacecraft, ESSA's especially instrumented aircraft, weather search radar, the ATS3 and ESSA 7 satellites and the conventional weather networks. This is the first time data from all of these observing tools were used to study the structure and dynamics of a hurricane. Techniques used in computing and integrating the various types of data are described and illustrated. A dominant feature of this immature hurricane was a large cloud which provided a major link between the low and high level circulations of the storm. Evidence is presented to suggest this type of cloud and its attendant circulation are features representative of tropical cyclones passing from the tropical storm to the hurricane stage. Author

N70-40798# Naval Weather Service, Washington, D.C.
SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS, NORTH AMERICAN COASTAL MARINE AREAS. VOLUME 7: AREA 20 - BAJA, AREA 21 - SAN DIEGO 200 SOUTHWEST, AREA 22 - SAN DIEGO, AREA 23 - SANTA ROSA
May 1970 639 p
(AD-709054) Avail: NTIS HC$10.00/MF$0.65 CSCL 4/2

The data contained in these tables were obtained from tape data Family 11 (TDF - 11), Marine Surface observations. TDF-11 was primarily funded by the Naval Weather Service Command and selected by NWSED Asheville as the most comprehensive collection of marine surface observations from which to develop a series of coastal marine summaries. The areas included in summary are Baha, San Diego, and Santa Rosa, California. Author (TAB)

N70-40810# Naval Postgraduate School, Monterey, Calif.
CLIMATOLOGICAL WAVE DATA FOR COLOMBO, CEYLON
Edward M. A. Perera (M.S. Thesis) Apr. 1970 87 p refs
(AD-709060) Avail: NTIS CSCL 8/3

Deep-water wave statistics for Colombo on the west coast of Ceylon have been compiled using the Sverdrup-Munk-Bretschneider wave-hindcast method applied to 12-hourly weather maps of the West Indian and South Atlantic Oceans for the one-year period from June 1968 through May 1969. Results of the wave-hindcast analysis are presented in the form of monthly and annual height-period-direction frequency distributions. The predominant waves are in the one to three foot height range, have periods centered about 13-14 seconds, and arrive from westerly to south-southwesterly directions. Wave action is most frequent in May through September and least in December. The wind waves and local swell on the west coast of Ceylon strongly reflect the seasonal Monsoons. The principal source of distant swell for this coast is the prevailing westerly wind belt of the Southern Hemisphere between Argentina and the longitude of Ceylon (80 degrees E). The subtropical anticyclone in the central Indian Ocean is a relatively quiet source region for swell compared to the Moonsoon belt and the prevailing westerlies. Author (TAB)

N70-40922# Environmental Data Service, Silver Spring, Md.
GROUND RAINFALL DATA FOR THE 1968 FLORIDA CLOUD SEEDING EXPERIMENT
B. G. Holzman and Marcella Thom Aug. 1970 18 p refs
(ESSA-TM-EDSTM-17) Avail: NTIS

Maps of ground rainfall data are depicted for Florida. These maps are for information only, and no conclusions are drawn for the verification of enhanced rainfall from seeded clouds. Author

N70-40984# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
SOME STATISTICAL ASPECTS OF POWER LAW PROFILES
W. B. Miller, L. E. Traylor, and A. J. Blanco May 1970 42 p refs
(AD-709610; ECOM-5303) Avail: NTIS CSCL 4/2

The report contains mathematical analysis for wind velocity versus height, time sequences of optimal p values obtained by two least-squares techniques are studied, together with associated residual sequences, to obtain information on wind profiles as related to impact prediction of the M50 (Honest John). Among pertinent results is the dependence of p on wind speed and turbulence, which offers an explanation of behavior of p observed by other investigators. Also, a means is presented whereby p may be studied independent of wind speed and turbulence which should be of interest to meteorologists. Author (TAB)

N70-41007# Institut Royal Meteorologique de Belgique, Brussels.
SPECTRUM ANALYSIS OF THE THREE WIND COMPONENTS AT 69 METERS ON THE MOL VERTICLE [ANALYSE SPECTRALE DES TROIS COMPOSANTES DU VENT A 69 METRES SUR LA VERTICALE DE MOL]
M. Legrand 1970 24 p refs In FRENCH; ENGLISH summary
/*ts* Publ. Ser. B, No. 58
Avail: NTIS

A spectrum analysis of the three wind components obtained from observations on a 120 m highly meteorological tower located in Mol (Belgium) is presented. From the examination of nearly 80 runs taken at a height of 69 m, each of one hour duration, the micrometeorological range of the turbulent kinetic energy spectrum between approximately 20 sec and 2 min was determined. The spectra depend clearly upon the average wind speed. The influence of the static stability of the atmosphere on the spectra is shown on the high period end of the lateral and vertical turbulent spectra (near 2 min). Some results are given on the dependence of the total turbulent kinetic energy with the average wind conditions and on the correlations between the wind components, the most important being the correlation between the longitudinal and the vertical wind components. The variation of the eddy viscosity coefficient K sub M with the average wind and static stability is pointed out. Author

N70-41023# Naval Oceanographic Office, Washington, D.C.
THE DYNAMIC STATISTICAL METHOD OF FORECASTING HYDROMETEOROLOGICAL PROCESSES AND ITS PRACTICAL APPLICATION [DINAMIKO-STATISTICHESKII METOD PROGNOZIROVANIYA GIDROMETEOROLOGICHESKIKH PROTSESSOV I YEGO PRAKTICHESKOE PRIMENENIE]
Yu. M. Alyokhin et al 1970 27 p refs Transl. into ENGLISH from PINRO (Murmansk), v. 12, 1968 p 123-138 refs
(AD-709127; NOO-Trans-493) Avail: NTIS CSCL 4/2

The forecasting of Series Q(T) is based on the Alyekhin method. Its essentials are as follows. The method is designed for forecasts with earliness varying from one to more years of the mean annual or seasonal phenomena averaged for areas not smaller than 50,000 square km. It consists of multiple linear extrapolation of multiannual series of macrophonomenon by using equation (1) defined in the text. The recommended source material for forecasting must be based on systematic observations for at least 50 years. The method can be used in forecasting phenomena whose correlated functions have a period not shorter than 8 years. The processing of forecasts requires the calculation of deviations from the mean value, of correlation function with the use of diagrams in the form of mean curves. To make the method more effective, additional research with regard to thermal and basic variables in various areas is necessary. TAB

N70-41044# Environmental Data Service, Silver Spring, Md.
GEORGIA TORNADOES
Horace S. Carter Jul. 1970 15 p refs
(ESSA-EDSTM-16) Avail: Issuing Activity

The number of tornadoes reported in Georgia from 1953 to 1969 is determined, and their frequency of occurrence is presented by county, month, and hour of day. The number of tornado deaths and injuries is listed by month and year; tornado property damage is categorized and presented in tabular form for the same 17-year period. Several outstanding Georgia tornadoes, including the well-known Gainesville storm of 1936, are described in some detail. ESSA's tornado warning service is described and suggested safety rules are listed. Author

N70-41095# California Univ., Berkeley. Hydraulic Engineering Lab.
OCEAN WAVE CLIMATE DISTRIBUTION FUNCTIONS:

TRANSLATIONS OF FOUR FRENCH PAPERS
Jean Larras et al May 1970 62 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), no. 260, 15 Mar. 1965 p 3125 - 3128; no. 265, 16 Aug. 1967 p 434 - 436; Trav. (France), Feb. 1969 p 119 - 120; Cah. Oceanogr. (Paris), v. 21, May 1969 p 487 - 501 In FRENCH and ENGLISH
(Contract DACW72-68-C-0016)
(AD-709634; HEL-1-15) Avail: NTIS CSCL 8/3

Contents: Probability of appearance of waves with amplitude greater than a given value; New research on the probability of appearance of waves with amplitude surpassing a given value; Random phenomena and the engineer: additive properties and the probability laws; and Statistical study of wave observations. TAB

N70-41114# Environmental Science Services Administration, Silver Spring, Md. Systems Development Office.
AN OBJECTIVE METHOD FOR FORECASTING WINDS OVER LAKE ERIE AND LAKE ONTARIO
Celso S. Barrientos Aug. 1970 23 p refs
(ESSA-TM-WBTM-TDL-34) Avail: NTIS

The importance of obtaining wind data over lakes was reemphasized. Developmental data consisted of 1000-mb geostrophic wind and sea-level pressure forecasts from the subsynoptic advection model for eight United States cities near the two lakes, as well as marine observations made by anemometer-equipped vessels. Two sets of regression equations for forecasting wind speed were derived by applying screening regression. The first yields wind speed by vectorial addition of two directional components; the second yields wind speed directly. Comparison further verifies that wind speed forecasts made by combining components are negatively biased. Author

N70-41127# Weather Bureau, Silver Spring, Md. Techniques Development Lab.
PROBABILISTIC PREDICTION IN METEOROLOGY: A BIBLIOGRAPHY
Allan H. Murphy (Michigan Univ.) and Roger A. Allen Jun. 1970 65 p refs
(ESSA-TM-WBTM-TDL-35) Avail: NTIS

A bibliography on the general subject of probability forecasting including papers on the fundamental principles of probability in this context is presented. Methods of making and using probability forecasts of weather events and methods of verifying and evaluating probability statements are included. The bibliography contains 683 items. Author

N70-41153# Weather Squadron (17th), Detachment 5, McChord AFB, Wash.
TERMINAL FORECAST REFERENCE FILE Final Report
25 Feb. 1970 109 p
(AD-709209) Avail: NTIS CSCL 4/2

The reference file discusses factors affecting the Weather at McChord AFB, WA. Included are location and topography, weather controls, climatic aids, and local forecast studies. Author (TAB)

N70-41205# National Environmental Satellite Center, Washington, D.C.
ESTIMATING CLOUD AMOUNT AND HEIGHT FROM SATELLITE INFRARED RADIATION DATA
P. Krishna Rao Jul. 1970 16 p refs
(ESSA-TR-NESC-54) Avail: NTIS

A simple statistical technique uses the difference between the actual surface temperature and the radiation temperature measured by the satellite as the prime input to yield a cloud height and amount classification for areas as small as one-degree latitude on a side. An example of the cloud information obtained from Nimbus-3 high resolution infrared (HRIR) data over the Barbados Oceanographic and Meteorological Expedition (BOMEX) area is shown. The method is designed for a completely automated production of cloud analyses or climatological studies on a global scale. Author

N70-41215# Texas Univ., Austin. Atmospheric Science Group.
RAINFALL PATTERNS NEAR THE UPPER TEXAS COAST
Frederick Max Haase Aug. 1970 66 p refs
(Grants NSF GA-367X1; NSF GA-16167)
(Rept-24) Avail: NTIS

Using rainfall data collected by the U.S. Weather Bureau, cooperative observers, and high school student volunteers, an analysis of rainfall was made for the coastal region between Houston and Beaumont. The object of this analysis was to discover what role, if any, the sea breeze played in determining the rainfall patterns in that area. The rainfall analysis was compared to McPherson's numerical sea breeze model, and two qualitative numerical models. Using the rainfall data collected for the days when the synoptic scale wind was less than 15 knots during the months of May through September for the year of 1966, the rainfall appears to be governed at least as much by the effects of coastal frictional divergence as by convergence related to the sea breeze circulation. Author

N70-41219# National Environmental Satellite Center, Washington, D.C.
OPERATIONAL BRIGHTNESS NORMALIZATION OF ATS-1 CLOUD PICTURES
V. R. Taylor Aug. 1970 18 p refs
(ESSA-TM-NESCTM-24) Avail: NTIS

An empirical brightness normalization schema, designed for the operational processing of ATS1 data, is described. It is based on an analysis of the dependence of brightness upon the solar zenith angle. The brightest clouds are adjusted to be equally bright over the entire picture and other darker values are proportionately adjusted by linear interpolation. Author

N70-41270# Weather Bureau, Silver Spring, Md. Techniques Development Lab.
REGRESSION ESTIMATION OF SURFACE WINDS Interim Report
Harry R. Glahn Jun. 1970 9 p refs
(Contract FA-67-WAI-131)
(FAA-RD-70-43) Avail: NTIS

Regression equations for estimating surface wind at 10 terminals in the Eastern United States were derived and tested on independent data. The predictors used were observed wind at initial time, 1000- and 500-mb geostrophic winds, and 1000-mb temperature. The temperatures and geostrophic winds were those predicted by numerical weather prediction models used by the weather Bureau. For a two month test period, the wind estimates from the equations were slightly more accurate than the wind forecasts made at local Weather Bureau offices. Author

N70-41308# Weather Bureau, Silver Spring, Md. Techniques Development Lab.
PREDICTING CEILING AND VISIBILITY WITH BOOLEAN PREDICTORS Interim Report
Roger A. Allen May 1970 41 p refs
(Contract FA-67-WAI-131)
(FAA-RD-70-37) Avail: NTIS

Predictors were developed for Seattle 3-hour ceiling and visibility prediction which were Boolean combinations of the simple weather elements observed at a network of stations. These Boolean predictors were intended to provide a more complete

formulation of the conditions which precede specified categories of ceiling and visibility than was possible with the simple predictors used in previous experiments. Better definition of the antecedent conditions should lead to improved probability forecasts of terminal weather. A test of one set of Boolean predictors was completed, and the verification results were examined. The forecasts made with these predictors were not as good as forecasts based on simple Predictors. For reasons discussed in the report, the results of this test should not be considered as final; however, it does appear that the development and application of Boolean predictors of this type for a large number of terminals would be much more costly than the use of simple predictors. Author

N70-41306# Environmental Technical Applications Center (Air Force), Washington, D.C.
ESTIMATED PROBABILITIES OF PATH-CUMULATIVE RAIN INTENSITY FOR PATHS OF 10 AND 22 NAUTICAL MILES IN HIGH RAIN-RATE AREAS Final Report
Gordon A. Beals Jun. 1970 33 p refs Prepared for FAA, Washington, D.C.
(FAA-RD-70-55) Avail: NTIS

Curves are presented which show the number of minutes per year that the product, rain rate times distance, exceeds any particular value on a 10-nautical mile path and a 22-nautical mile path in southern Florida and in coastal Burma. The curves were derived from fairly reliable estimates of the number of minutes per year that given point rainfall rates occur and a hypothetical model of the probability of path cumulative rainfall for various point rainfall rates. The results are applicable to calculations of rain attenuation of microwave signals in areas having large annual rainfall. This application is illustrated in an appendix. Author

N70-41324# Stanford Research Inst., Menlo Park, Calif.
THEORETICAL CONSIDERATIONS FOR DESCRIBING THE STATE OF THE SKY THROUGH AUTOMATIC TECHNIQUES Final Report
R. O. Duda, R. L. Mancuso, and R. H. Blackmer, Jr. May 1970 179 p refs
(Contract FA-65-WAI-96)
(FAA-RD-70-13) Avail: NTIS

A computer model is described for the simulation of optical and radar ceilometers. The model has two components, a statistical cloud model that describes a sky composed of multiple layers of random clouds, and an instrument model that permits the calculation of the responses of ceilometers. The digital computer program based on this model is described, and program flowcharts, listings, and sample printout are given. Author

N70-41393 National Lending Library for Science and Technology, Boston Spa (England).
ON AN EXCEPTIONAL NIGHT MAXIMUM TEMPERATURE
N. Crema 29 May 1970 4 p Transl. into ENGLISH from Riv. Meteorol. Aeronaut. (Italy), v. 29, no. 1, Jan.-Mar. 1969 p 55-56
(NLL-M-9152-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The occurrence of the daily maximum at 0200 GMT on 5 May 1968 at Falconara, Italy is reported. Data to substantiate the observation are presented and includes: (1) a drop in relative humidity coincides with the jump in temperature; (2) the Udine 0000 GMT sounding shows a temperature of 18 C at 990 mb; (3) strong advection of warm air across Central Italy at 850 mb; and (4) a SW foehn wind resulted in additional warming of a warm air mass. F.O.S.

N70-41492 National Lending Library for Science and Technology, Boston Spa (England).
ON PENETRATION OF SOLAR RADIATION INTO WATER
F. E. Arae et al. 29 May 1970 11 p refs Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluzh., Met. Gidr. (Leningrad), no. 6, 1969 p 58-64
(NLL-M-9112-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Developed is an approximation to the law of total extinction of solar radiation with depth that is valid for any water area. Evaluated is the relationship between measured data of water transparency, total solar radiation, and water surface albedo. G.G.

N70-41503# Weather Bureau, Silver Spring, Md. Office of Hydrology.
JOINT PROBABILITY METHOD OF TIDE FREQUENCY ANALYSIS APPLIED TO ATLANTIC CITY AND LONG BEACH ISLAND, N.J.
Vance A. Myers Apr. 1970 114 p refs
(ESSA-TM-WBTM-HYDRO-11) Avail: NTIS

The frequency analysis of combined storm surges and periodic tides prepared as part of the Long Beach Island study is discussed. These frequencies apply to the ocean beach. Studies of wave action and possible variations in water levels inshore from the ocean side of the Island, mapping of the community, and elevation determination of structures are not included. Hurricane frequency and astronomical tide and time displacement probability methods are described with hurricane surge models. Hurricane climatology, and the Jelesnianski method for hurricane surge analysis are summarized, as well as astronomical tides and sea level. Winter storm surges and astronomical tides are included along with tide frequencies for all storms and an appraisal of tide frequencies. Author

N70-41551# Woods Hole Oceanographic Institution, Mass.
BOMEX METEOROLOGICAL DATA
Andrew F. Bunker Aug. 1970 30 p refs *Its* Reference No. 70-34
(Grant NSF GA-1700)
Avail: NTIS

CONTENTS:

1. TURBULENT FLUXES OBSERVED FROM THE WHOI AIRCRAFT, PART 1 A. F. Bunker p 1-15 refs (See N70-41552 23-20)

2. SOLAR RADIATION AVERAGES FROM WHOI AIRBORNE PYRANOMETER MEASUREMENTS, PART 2 A. F. Bunker p 16-29 (See N70-41553 23-20)

N70-41552# Woods Hole Oceanographic Institution, Mass.
TURBULENT FLUXES OBSERVED FROM THE WHOI AIRCRAFT, PART 1
Andrew F. Bunker *In its* BOMEX Meteorol. Data Aug. 1970 p 1-15 refs (See N70-41551 23-20)
Avail: NTIS

The turbulence and turbulent flux observations made from the WHOI C-54 aircraft on ten days between 26 June and 28 July 1969 are reported. Root-mean-square values of the vertical and horizontal components of the turbulent velocity, the temperature and humidity fluctuations, and the turbulent fluxes of sensible heat, latent heat, momentum, and kinetic energy are tabulated together with supplementary position and weather information. Ninety seven individual one-minute runs were processed which were made at altitudes from 15 to 1400 meters. The method of obtaining the observations and computing the turbulence parameters are discussed. Averages of the values for several height ranges are formed for both undisturbed and disturbed conditions of the trade winds. The decrease in the average downward flux of sensible heat is produced by the presence of numerous upward fluxes in disturbed areas. The lower average latent heat flux for disturbed conditions is the result of numerous large negative fluxes in the 200 to 500 meter layer outweighing increased positive latent heat fluxes in the lowest 200 meters. The average shearing stresses in the lowest 400 m are 0.5 dynes/sq cm for undisturbed conditions and 0.8 dynes/sq cm for disturbed conditions. Author

N70-41553# Woods Hole Oceanographic Institution, Mass.
SOLAR RADIATION AVERAGES FROM WHOI AIRBORNE PYRANOMETER MEASUREMENTS, PART 2
Andrew F. Bunker *In its* BOMEX Meteorol. Data Aug. 1970 p 16-29 Presented at the AUG-AMS Meeting, Washington, D.C., Apr. 1970 (See N70-41551 23-20)
Avail: NTIS

Measurements of solar radiation made from the WHOI C-54 were processed and transmitted to the BOMAP data center for entry onto magnetic tapes. A brief description of the observations and their processing is given, together with areal averages of the radiation values. Author

N70-41572 National Lending Library for Science and Technology, Boston Spa (England).
THE EFFECT OF RELIEF ON THE SPREADING OF IMPURITY FROM SOURCES
M. E. Berljand et al 29 May 1970 20 p refs Transl. into ENGLISH from Tr. Glav. Geof. Obs. (Leningrad), No. 234, 1968 p 28-44
(NLL-M-9130-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The changes in the distribution of the concentration of impurities caused by the distortion of air flow by surface irregularities are studied by using hydrodynamic methods based on the numerical solution of an equation of turbulent diffusion in a region with a curvilinear boundary. The problem is solved by a computer using a program developed to study diffusion over horizontally homogeneous terrain. The effects of the leeward and windward slopes on the concentration of impurities are discussed. It is concluded that possible maximum concentrations from a source of fixed height are greater in hilly terrain than on flat land. F.O.S.

N70-41587# Air Force Global Weather Central, Offutt AFB, Nebraska.
AFGWC MACRO-SCALE BAROCLINIC PREDICTION MODEL
Kenneth J. Palucci 15 Mar. 1970 21 p refs
(AD-709368; AFGWC-TM-70-4) Avail: NTIS CSCL 4/2

A six-level quasi-geostrophic prediction model has been in use at the Air Force Global Weather Central since 1965. The model produces forecasts of wind, pressure-height, vertical velocity, stream function and temperature for up to 72 hours. The installation of a larger computer system in 1968-1969 has allowed significant changes in the model. Improvements include a refined smoothing technique, use of higher order terms in the calculation of vorticity advection, and the inclusion of a new wind computational technique. Author (TAB)

N70-41613# Air Force Global Weather Central, Offutt AFB, Nebraska.
AFGWC MESO-SCALE PREDICTION MODEL
James Kerlin 15 Mar. 1970 21 p refs
(AD-709367; AFGWC-TM-70-1) Avail: NTIS CSCL 4/2

The report describes an upper air numerical forecast model designed to compute 0-24 hour forecasts for a limited area (window) using a grid spacing of 183 kilometers. Forecasts are computed at one-half hour time steps. Forecast levels are 850, 700, 500, 300 mbs. Analysis data are required at the same levels and for the same grid spacing. Boundary values are required from a hemispheric model. This model is designed to obtain higher resolution in the description of atmospheric features smaller than those portrayed by conventional macro-scale numerical forecast models. It is used at the AFGWC to provide forecast data at the top level of the AFGWC boundary layer (1,600 meters above the terrain). The meso-scale prediction model is expandable to hemispheric applications. Author (TAB)

N70-41615# Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
EFFECTS OF HURRICANE CAMILLE ON THE LANDSCAPE OF THE BRETON-CHANDELEUR ISLAND CHAIN AND THE EASTERN PORTION OF THE LOWER MISSISSIPPI DELTA
Lynn D. Wright, Frank J. Swaye, and James M. Coleman Feb. 1970 25 p refs Repr. from Coastal Studies Bulletin 4
(Contracts Nonr-1575(03); Nonr-1575(00))
(AD-709427; TR-76) Avail: NTIS CSCL 4/2

Air and ground reconnaissance immediately following the passage of Hurricane Camille disclosed significant modifications to the natural landscape of the Breton-Chandeleur Island arc and to the eastern portion of the lower Mississippi Delta. Considerable dissection and redeposition was evident along beach and barrier formations, and total obliteration dominated numerous sections. Trends of redistributed beach material strongly reflected the final direction of hurricane-induced mass transport of water. In the lower delta damage was mainly to marsh vegetation and was attributable to high water and surge currents directed almost entirely from north to south. Author (TAB)

N70-41715# Air Weather Service, Scott AFB, Ill.
VARIABILITY OF THE MONTHLY MEAN ZONAL WIND, 30-60 KM
Lloyd V. Mitchell Apr. 1970 95 p refs
(AD-709727; AWS-TR-195) Avail: NTIS CSCL 4/1

The report presents an analysis of the monthly mean zonal wind and the standard deviation of the zonal wind about the monthly mean. The data are presented in tables and the analyses in time (months)-altitude (30 to 60 kilometers) cross-section as well as profiles for selected levels. The variability of the monthly mean zonal wind, 30 to 60 kilometers, is discussed by individual station. Also, there is a discussion of the altitudinal, latitudinal, monthly, and seasonal variations with a designation of four seasons - winter (dominated by westerlies but with occasional easterlies), November through March; spring transition of westerlies to easterlies, April and May; summer (persistent easterlies), June through August; and fall transition of easterlies to westerlies, September and October. Author (TAB)

N70-41718# Weather Wing (1st), San Francisco, Calif. 96553
JULY CLIMATE OF SOUTHEAST ASIA Final Report
1970 78 p *Its* Spec. Study No. 105-11/7 Supersedes AD-482774
(AD-709725; AD-482774) Avail: NTIS CSCL 4/2

The report deals with the climate of North Vietnam, Republic of Vietnam, Laos, Cambodia and Thailand for July. Essentially based on previously available data, however, precipitation analyses, ceiling/visibility, and upper air flow are new. Contains brief notes on the climate of Southeast Asia and the geographical features of the Republic of Vietnam, North Vietnam, Cambodia, Laos, and Thailand. Discusses the precipitation, thunderstorms, cloudiness, visibility and obstructions to vision, combined ceiling/visibility, temperature, relative humidity, surface and upper winds, miscellaneous phenomena and sea operations. Contains a station locator and topography map. Isoline analyses (map scale 1:9,000,000) are given for precipitation days, mean, maximum, and minimum precipitation, days with thunderstorm, mean cloudiness, percent frequency of ceiling/visibility = or > 5000/5 and = or > 1000/2 1/2 (7 and 16 LST), daily max and min temperatures and mean relative humidity. For selected stations tabular data on fog days, percent frequency visibility < 1 mile and < 5 miles (7 and 16 LST) are given also. Mean streamline charts (1:37,500,000) are given for 2000 ft, 850 mb, 700 mb, 500 mb, 300 mb, and 200 mb levels. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking inertial platforms; and air traffic control. For related information see also: 07 Communications.

N70-40421# National Aerospace Lab., Tokyo (Japan).
GUIDANCE ERRORS OF THE GUIDANCE SYSTEMS APPLYING EXPLICIT GUIDANCE. THE EFFECTS OF THE NAVIGATION AND CONTROL SYSTEMS ON THE GUIDED TRAJECTORY
Koichi Matsushima, Keiji Nitta, Kohji Otsubo, and Toru Shiho 1970 18 p refs In JAPANESE; ENGLISH summary
(NAL-TR-194) Avail: NTIS

Digital simulations to determine the effects of navigation system and control system errors on rocket trajectories are presented. The following results are explained: (1) velocity measurement errors are most sensitive to the guidance function in comparison with other navigational errors, (2) a higher response of the attitude control dynamics is required for improved orbit accuracy, and (3) the total guidance error is the sum of the navigation and control system errors. Author

N70-40441# National Aerospace Lab., Tokyo (Japan).
SIMULATION STUDY OF HYDRAULIC SERVO SYSTEM WITH CONSIDERATION OF NON-LINEAR FLOW CHARACTERISTIC OF SERVO VALVE
Hajime Koshiishi, Takahiro Suzuki and Mitsuyoshi Nakamura 1970 14 p refs In JAPANESE; ENGLISH summary
(NAL-TR-193) Avail: NTIS

The simulation of a gimbal engine hydraulic servo system for rocket attitude control is discussed. The hydraulic servo system is simulated by a mathematical model in which a servo valve is considered as a non-linear element subjected to the square root law of pressure difference across the spool port. Results of the simulation have shown that a mathematical model can accurately describe the dynamic behavior of a hydraulic servo system with large inertia and resonant loads. Author

N70-40743*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN APPROACH GUIDANCE METHOD USING A SINGLE ONBOARD OPTICAL MEASUREMENT
Harold A. Hamer and Katherine G. Johnson Washington Oct. 1970 82 p refs
(NASA-TN-D-5963; L-7053) Avail: NTIS CSCL 17G

An empirical method was developed for onboard guidance within the sphere of influence of a celestial body. For guidance maneuvers made at a relatively large distance from the body, only one preselected measurement from a star to the body is required. Although the method is designed to control the magnitude of the periapsis radius (or entry angle), the periapsis position and velocity automatically remain close to the nominal values. For lunar approach, error analysis with an assumed one-sigma error of 10 seconds of arc in the optical angular measurements and a one-sigma velocity-cutoff error of 0.2 m/sec has shown that periune radius can be controlled to a one-sigma accuracy of from 7 to 13 km, depending on the time the approach guidance is performed. Author

N70-40783# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
EXPANSION OF AUTOMATION IN TERMINAL ATC FACILITIES
John C. Mercer *In its* Res. and Develop. Rept. to Ind. Jun. 1969 25 p (See N70-40776 23-02)
Avail: NTIS

A brief picture of some of the more interesting and challenging expansion items of the FAA's Terminal Automation System is presented. Included in the discussion are: (1) installation of the ARTS-3 Beacon Tracking Level of automation at 64 towers; (2) automation of the ARTCCs and TRACONs; (3) addition of alphanumeric data to the BRITE tower display; (4) terminal flight data distribution system; (5) surface control of aircraft in areas not visible from the control tower; and (6) use of computers in metering, sequencing, and spacing of aircraft in the terminal area. A.L.

N70-40784# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
ALL WEATHER LANDING DEVELOPMENT TESTS
James R. Nelson *In its* Res. and Develop. Rept. to Ind. Jun. 1969 13 p (See N70-40776 23-02)
Avail: NTIS

FAA conducted tests of an airborne system designed for use in landings where the runway visual range is 150 feet are described. The tests were successful and demonstrated that, with certain limitations, initial flight operations in Category 3B weather should be feasible. The tests were conducted in a C-141 and were part of a joint program with the Air Force to develop an all weather landing system in the C-141. The Category 3 system was designed so that the approach and landing would be made fully automatic, and that the automatic system would flare, decrab, and steer along the runway until rudder effectiveness diminished. The pilot's flight director system was specially designed to compute and display flare, decrab, and runway steering commands for him. Results of the program illustrated that the automatic system was sufficiently accurate to land the aircraft safely on a 150-foot wide runway under any environmental conditions suitable for landing. A.L.

N70-40785# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
VISIBILITY MEASUREMENT FOR AVIATION USE
Edmund Bromley, Jr. *In its* Res. and Develop. Rept. to Ind. Jun. 1969 15 p refs (See N70-40776 23-02)
Avail: NTIS

The development of all weather landing systems requires a reassessment of the credibility of the present system for providing visibility information to the pilot. Results of recent efforts in determining the credibility of the present Runway Visual Range (RVR) System and in analyzing the limitations and capabilities of this system indicate that for values of RVR below 600 feet, development of new techniques is essential. The need for standardization on an international basis of the characteristics of Runway Visual Range systems influences the direction of these development efforts. The technical feasibility of a laser to measure transmissivity has been demonstrated and an approach to providing visibility data in terms of visual range is outlined. Author

N70-40786# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
APPLICATION OF TIME ORDERED TECHNOLOGY TO THE FUTURE NAS
Philip J. La Rochelle *In its* Res. and Develop. Rept. to Ind. Jun. 1969 29 p (See N70-40776 23-02)
Avail: NTIS

Forecasts of air traffic demand on the airspace, and the requirements for safety and efficiency, dictate the need to evaluate new technological areas. One area is concerned with establishing and maintaining precisely synchronized time and frequency references between aircraft and ground stations. The performance capability of Time-Ordered(T/F) system concepts when applied specifically to the anticipated growth of the National Airspace System was investigated. Results of this investigation were: (1)T/F technology has the capability of providing many aeronautical functions from a single basic system design; (2) development of system methodology for synthesizing air traffic control concepts, assessing relative system performance, and projecting system behavior under various traffic loads; and (3) synthesis of a tentative hybrid T/F system for air traffic management that appears to satisfy the needs for communications, navigation, collision avoidance, and flow control for the 1980 to year 2000 National Airspace System. A.L.

N70-40802# Naval Oceanographic Office, Washington, D.C.
RESULTS WITH A DEEP RESEARCH VEHICLE TRANSPONDER NAVIGATION SYSTEM AT THE US NAVAL OCEANOGRAPHIC OFFICE

Roger Merrifield and Roger R. Delort 1970 9 p
(AD-708406) Avail: NTIS CSCL 13/10

An acoustic transponder navigation system has been fabricated by the U.S. Naval Oceanographic Office for use on Deep Research Vehicles. The system can be used for guidance of a vehicle during a survey mission by monitoring an oscilloscope display or it can be used for track reconstruction following a reconnaissance mission by play-back of the magnetic tape record. Results from this navigation system on operations with CUBMARINE (PC3-B), ALVIN, and STAR III in both the survey and the reconnaissance modes are presented. Author (TAB)

N70-40834# Naval Ship Systems Command, Washington, D.C.
ILS DEVELOPMENT AND IMPLEMENTATION
Richard Dangel 1970 48 p refs Presented at the 7th Ann. Tech. Symp. of Assoc. of Senior Engr., 1970
(AD-709123) Avail: NTIS CSCL 17/7

The report examines progress and problems in Integrated Logistic Support development and implementation during 1969, in the U. S. Naval Ship Systems Command. It contains discussions in five major areas: (1) How ILS is being implemented on a major ship system acquisition (2) Development and highlights of the recently issued Maintenance Engineering Analysis Specification MIL-M-24365(SHIPS) 26 May 1969; (3) Progress and planning for ILS training and ILS career management program; (4) How NAVSHIPS is organized for ILS, changes made and changes recommended; and (5) Remaining problems in ILS implementation. Author (TAB)

N70-40927# Federal Aviation Administration, Washington, D.C.
THE THIRTY-THIRD COLLISION PREVENTION ADVISORY GROUP (COPAG) MEETING
28 May 1969 67 p refs Conf. held at Middle River, Md., 28 May 1969
Avail: NTIS

CONTENTS:

1. SIMULATION STUDY OF NASA/ERC OPTICAL PILOT WARNING INDICATOR IN TERMINAL AREA TRAFFIC J. R. Ruetenik, J. H. Thompson (Kaman AviDyne), C. H. Leigh, and A. S. Richardson, Jr. (NASA, ERC) p 1 - 47 (See N70-40928 23-21)
2. LANGLEY PWI PROGRESS REPORT J. Schrader p 48 - 53 (See N70-40929 23-21) N70-40932 23-21)
3. COLLISION AVOIDANCE SYSTEM STUDY B. N. MacDonald (Instr. Systems. Corp.) p 54-56 (See N70-40930 23-21)
4. PROJECT SUMMARY FOR INTER-SERVICE COORDINATING /WORKING GROUP. SIMULATION AND ANALYSIS OF ATC /CAS SYSTEM DESIGN p 57-64 refs (See N70-40931 23-21)
5. ANALYSIS OF VISUAL SEPARATION TECHNIQUES AND TEST OF PWI EQUIPMENT STATUS REPORT p 65-67 (See N70-40932 23-21)

N70-40928*# Kaman AviDyne, Burlington, Mass.
SIMULATION STUDY OF NASA/ERC OPTICAL PILOT WARNING INDICATOR IN TERMINAL AREA TRAFFIC
J. Ray Ruetenik, John H. Thompson, Charles H. Leigh (NASA, ERC), and Albert S. Richardson, Jr. (NASA, ERC) *In* FAA 33d Collision Prevent. Advisory Group (COPAG) Meeting 28 May 1969 p 1-47 (See N70-40927 23-21)
(Contract NAS12-698)
Avail: NTIS CSCL 17G

Results of a digital simulation study of terminal area traffic and a pilot warning indicator (PWI) system, based upon the detection of infrared energy emitted by a light source placed on each aircraft, are presented. The CASTE (collision avoidance system technical evaluation) computer program is described; hazard criteria are used to evaluate the alarm system. The four hazard criteria employed are range-altitude guard, acceleration criterion, tau criterion, and modified tau criterion. The sequence of alarm events are studied during many encounters, and the statistics of valid alarms, false alarms, and missed alarms are compiled and examined. Methods for reducing the false alarm ratio are reported. P.A.B.

N70-40929*# Federal Aviation Administration, Washington, D.C.
LANGLEY PWI PROGRESS REPORT
James Schrader *In its* 33d Collision Prevent. Advisory Group (COPAG) Meeting 28 May 1969 p 48-53 Sponsored in part by NASA (See N70-40927 23-21)
Avail: NTIS CSCL 17G

Experimental and analytical work in the area of pilot warning of collision hazards is reported. The experimental work consists of the development and evaluation of a cooperative, C.W., Doppler technique which utilizes the variation in received signal level as an approximate measure of range and the Doppler frequency shift as a measure of closing velocity. Data analysis to determine the warning statistics associated with various warning criteria is discussed, and some results are illustrated. P.A.B.

N70-40930# Instrument Systems Corp., Huntington, N.Y.
COLLISION AVOIDANCE SYSTEM STUDY
Bruce N. MacDonald *In* FAA 33d Collision Prevent. Advisory Group (COPAG) Meeting 28 May 1969 p 54-56 (See N70-40927 23-21)
(Contract N00019-68-C-0196)
Avail: NTIS

The study, intended to define and demonstrate the feasibility of a non-time frequency aircraft collision avoidance system, includes an analysis of required measurement resolution, traffic handling capability, and avoidance maneuver determination information. The analysis is followed by the definition and building of a system to make the required measurements, determine the degree of hazard, and predict the required avoidance maneuver. The system designed consists of two units, an interrogator and a transponder. The interrogator is composed of a bearing encoder device, a pulse correlator, a range encoder, a computer, and a display, all of which are built excepting the bearing encoder, which is reported under construction. Preliminary tests and their results are reported, and two problem areas associated with the system are mentioned. P.A.B.

N70-40931# Federal Aviation Administration, Washington, D.C.
PROJECT SUMMARY FOR INTER-SERVICE COORDINATING/WORKING GROUP. SIMULATION AND ANALYSIS OF ATC/CAS SYSTEM DESIGN
In its 33d Collision Prevent. Advisory Group (COPAG) Meeting 28 May 1969 p 57 64 refs (See N70-40927 23-21)
Avail: NTIS

In an effort to find the order of magnitude of expected interaction between the collision avoidance system (CAS) and the air traffic control (ATC) system, a small sample of real world track history data was gathered and analyzed. Eleven sample hours of positional data were recorded using the advanced radar tracking system. Counts of CAS-detected events and threat duration data were provided. Two sets of CAS parameters were exposed to the sample data; representative results are given. The reduction of the number of threat events found by the proposed terminal area parameters as compared to the enroute parameters was in the order of 20 to 1. Plans for real time digital simulation of the overall project are described. P.A.B.

N70-40932# Federal Aviation Administration, Washington, D.C.
ANALYSIS OF VISUAL SEPARATION TECHNIQUES AND TEST OF PWI EQUIPMENT Status Report
In its 33d Collision Prevent. Advisory Group (COPAG) Meeting 28

May 1969 p 65 - 67 (See N70-40927 23-21)
Avail: NTIS

The project deals with the visual collision avoidance problem as related to general aviation aircraft and is intended to seek a solution to this type of problem by implementing a low cost pilot warning instrument. The objectives of the project are outlined, along with the schedule of planned reports. P.A.B.

N70-40960*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

EXPERIENCE WITH UNPOWERED TERMINAL AREA INSTRUMENT APPROACHES

B. Lyle Schofield, Harold G. Gaidsick, and Shu W. Gee *In its* Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 133 - 147 (See N70-40951 23-31)
Avail: NTIS CSCL 17G

A terminal area guidance technique developed around the F-111A inertial navigation system is discussed for application to the return of a manned space shuttle vehicle to a predetermined runway. The results of flying under instrument flight rules using the guidance technique and the results of ground controlled approaches using an NB-52B aircraft in an unpowered, low lift-to-drag configuration are reported. A circular approach guidance scheme under development for the space shuttle vehicle is considered. Author

N70-40961*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AUTOMATIC AND MANUAL TERMINAL GUIDANCE AND CONTROL STUDIES IN SUPPORT OF THE SPACE SHUTTLE PROGRAM

D. W. Smith *In its* Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 149 - 154 (See N70-40951 23-31)
Avail: NTIS CSCL 17G

The technology requirements for designing a terminal area navigation, guidance, and control system suitable for automatic or piloted landings of space shuttle vehicles under Category 2 conditions are discussed. The problems associated with the high cross-range orbiter are emphasized, although the low cross-range vehicle is also examined. The research program is divided into three phases of analysis, simulation, and flight testing. The technical objectives of each phase and the status of each of the separate research investigations are described. Author

N70-40962*# Sperry Phoenix Co., Ariz.

TERMINAL CONTROL AND AUTOMATIC LANDING OF UNPOWERED SPACE SHUTTLE VEHICLES

Stephen S. Osder *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 155 - 176 (See N70-40951 23-31)
Avail: NTIS CSCL 17G

Guidance and control techniques used to accomplish terminal energy management and automatic horizontal landings of unpowered vehicles are described. The concepts discussed were previously used in the X-20 Dynasoar remote recovery system. This system was to acquire the Dynasoar glider at an altitude of about 120,000 feet and provide the guidance and energy management for an automatic landing of an unmanned, single orbit, test flight. The final approach and landing concepts are also similar to the manual techniques used in landing lifting body vehicles in VFR conditions. Author

N70-40963*# North American Rockwell Corp., Downey, Calif.

STABILIZATION AND CONTROL OF THE SPACE SHUTTLE ORBITER DURING ENTRY/PITCHDOWN MANEUVERS

D. Engels, E. Estrine, and P. Shipley *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 176 - 192 (See N70-40951 23-31)
Avail: NTIS CSCL 17G

Results of recent shuttle entry flight control studies are discussed with respect to both high and low L/D orbiter vehicles. A pitchdown control system for the low L/D orbiter is synthesized, and typical time histories are shown. Effects of variations and uncertainties in aerodynamic parameters on the entry control problem are discussed. Author

N70-40966*# Grumman Aircraft Engineering Corp., Bethpage, N.Y.

FLY-BY-WIRE

E. Bumby *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 227 - 235 (See N70-40951 22-31)
Avail: NTIS CSCL 17G

The major design problems involved in designing a fly-by-wire flight control system for space shuttle vehicles are considered. Projected implementations integrate the fly-by-wire function within the automatic flight control system, with feedback control providing a stability augmentation system. Available data indicate that a quadruple-redundant configuration is required to provide the reliability of the mechanical system which the fly-by-wire system replaces. R.B.

N70-40970*# International Business Machines Corp., Gaithersburg, Md.

INSTRUMENT LANDING SYSTEMS FOR THE SPACE SHUTTLE

Herbert P. Raabe *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 295 - 312 (See N70-40951 23-31)
Avail: NTIS CSCL 21G

The terminal flight characteristics of the returning space shuttle are described and the requirements for an instrument landing system (ILS) are derived. The presently available systems are reviewed and their deficiencies to serve the shuttle are pointed out. The efforts of a special committee in defining future requirements for aircraft ILS's, screening proposed techniques for their potential in meeting these requirements, and establishing a common waveform are reported. The requirements for space shuttle and aircraft landing operations are compared. An ILS concept potentially capable of meeting shuttle and aircraft requirements is described. Author

N70-40999*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.

THREE-AXIS ORIENTATION AND STABILIZATION OF A PROBE USING SOLAR PRESSURE

Luat T. Nguyen (M.S. Thesis) 31 Aug. 1970 155 p refs
(Grant NGL-22-009-019)
(NASA-CR-113813; CSR-T-70-4) Avail: NTIS CSCL 17G

The possibilities of using solar pressure torques to perform three-axis orientation and stabilization of a small probe are considered. The attitude control system is to maintain one spacecraft axis perpendicular to the ecliptic plane and another axis pointed closely to the sun. This orientation allows the use of a high gain directional antenna which tracks the earth through a single rotation in the ecliptic. The three main elements of the control loop are analyzed: (1) attitude sensing, (2) spacecraft dynamics, and (3) control torque production. A workable design is evolved which satisfies all the attitude control requirements while retaining the features of simplicity and low weight. Author

N70-41040*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Lab.

DETERMINATION OF THE OPTIMUM RESOLUTION ELEMENT FOR A PILOT WARNING INDICATOR

Thomas Basil Smith, III (M.S. Thesis) Jun. 1970 112 p refs
(Grant NGR-22-009-444)

(NASA-CR-113808; MVT-70-4) Avail: NTIS CSCL 17G

Experiments were performed in order to determine how accurately the PWI device need establish the direction of an incoming threatening aircraft. A PWI resolution was sought such that near optimum pilot performance could be expected and such that no excessive resolution need be purhcased. Examination of the data revealed that a resolution element of about 11 deg by 11 deg is optimal for a low cost device. Resolution of about 6 deg by 6 deg gives somewhat better pilot performance, but the increased cost of instrumenting this reduced sector size was not justified by the slight increases in pilot performance. Author

N70-41043# Federal Aviation Administration, Washington, D.C.
USE OF COMPUTERS IN AIR TRAFFIC CONTROL
Jun. 1970 35 p
Avail: NTIS

In an effort to meet growing demands for air traffic, an automatic air traffic control program is being developed. When completed, the combined system will provide automation at each of the 20 air route traffic control centers, and those terminals where automation is warranted. All of these facilities will be interconnected with data transmission links, and the entire system will function as a nationwide, realtime automated system. This automation program is intended to provide increased safety to the existing air traffic control system. The enroute portions of the automation program and terminal are discussed. Author

N70-41045# Honeywell, Inc., St. Petersburg, Fla. Aerospace Div.
CENTAUR IN RETROSPECT: A DECADE OF GUIDANCE IMPROVEMENTS
Ronald M. Rasmussen [1970] 20 p refs
Avail: NTIS

A brief description of guidance configurations and achievements of the sixties, and a look at some applications planned for the seventies are given. The technical disciplines of design, development parts control, and reliability which were largely responsible for the success of the guidance equipment are reviewed. Author

N70-41058# Anacapa Sciences, Inc., Santa Barbara, Calif.
PROCEEDINGS OF THE GEOGRAPHIC ORIENTATION IN AIR OPERATIONS SYMPOSIUM
James J. McGrath, ed. JANAIR Apr. 1970 320 p refs Conf. held at Washington, D.C., 18-20 Nov. 1969; sponsored by JANAIR
(Contract N00014-70-C-0066)
(AD-709124; Rept-101-1) Avail: NTIS CSCL 17/7

The document records the proceedings of a symposium on geographic orientation of aircraft pilots during various phases of air operations. The meeting was attended by experts in the fields of technology related to the development and use of aeronautical charts and map-display systems for manned aircraft. The principal topics of the symposium were user requirements, cartographic developments, map-display design, CRT/map displays, human factors and systems analysis studies, cartographic support of map displays, and field evaluations of map displays. The recorded proceedings include the manuscripts of a keynote address and 30 technical papers, edited transcripts of the discussions that followed the papers, summary reports of five special discussion groups, a special report of JANAIR research in this field, an overview of the symposium proceedings, and a directory of the participants. Author (TAB)

N70-41067*# TRW Systems Group, Redondo Beach, Calif.
AN ANALYSIS AND EVALUATION OF GUIDANCE MODES
Final Report
C. G. Pfeiffer 1 May 1970 179 p refs
(Contract NAS12-593)
(NASA-CR-113902) Avail: NTIS CSCL 17G

The general characteristics of powered flight guidance algorithms (modes) developed for space missions are described and analyzed. The modes are classified according to their characteristics; measures of performance are defined, and each subclass is assigned a qualitative performance rating. Selected guidance modes described in the literature are classified and described. The targeting problem, which is the task of describing desired end conditions for a guidance phase, is discussed. Author

N70-41088*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ATM STAR TRACKER VEHICLE STRUCTURE OCCULTATION STUDY
C. E. Lee 19 May 1969 27 p
(NASA-TM-X-53836) Avail: NTIS CSCL 17G

A computer study was performed to evaluate the vehicle occultation of the ATM star tracker. Reference stars Canopus, Achernar, and Alpha Crux were selected. The criteria used in selecting these stars were based on the mission requirements, position of the stars, characteristics of the stars, and the tracker design. This study has considered the 'worst case' constraints: a 35 + or − 2 degrees orbital inclination angle; a + or − 7.5 degrees orbital plane—principal axis misalignment of the spacecraft; a docking misalignment of + or − 10 degrees; and a reflection zone of 15 degrees around the orbital workshop solar array. Occultation graphs indicate the necessity for three reference stars to reduce the possibility of simultaneous occultation. The graphs also indicate that 2 to 3 day periods of vehicle occultation could occur (depending on the launch hour and day) if the docking error exceeds approximately 5 degrees. Author

N70-41089*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STABILIZATION AND CONTROL OF THE APOLLO TELESCOPE MOUNT
W. B. Chubb 6 May 1969 30 p refs
(NASA-TM-X-53834) Avail: NTIS CSCL 17G

The prime requirement of the Apollo Telescope Mount (ATM) is to accurately point an experiment package containing a complement of solar experiments to acquire data on solar phenomena. The system is composed of a control moment gyro (CMG) subsystem for vehicle control and a coupled experiment pointing control (EPC) subsystem for experiment control. The EPC subsystem, utilizing flex-pivot gimbal bearings for two axes control, was developed to assist the CMG control subsystem in meeting experiment spar performance specifications. The requirements placed upon the two-degree-of-freedom control moment gyroscopes used for vehicle control confronted the design engineers with many challenging problems. These included control of individual CMG vectors, disturbance torque minimization, and CMG desaturation problems. Finally, extension of ATM technology for utilization on advanced ATM stellar telescopes is considered. Author

N70-41091*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN IMPROVED CONTROL SYSTEM FOR THE APOLLO TELESCOPE MOUNT
M. T. Borelli 1 Apr. 1969 21 p refs
(NASA-TM-X-53830) Avail: NTIS CSCL 17G

A different method of operating the present control system for the Apollo Telescope Mount's control moment gyro is presented. This method results in a broader bandwidth for the control system and consists of modifying the double-gimbal control moment gyros to operate in a single-gimbal mode during all solar experimental periods. If the inner gimbals are used for dynamic control, then the outer gimbals would be inhibited or rigidly clamped to the frame during the experiments. Between experiments, the inhibited outer

gimbals would be oriented to maximize the momentum storage capability of the system. The expected increase in bandwidth is from two to three times the present system bandwidth. Inner to outer gimbal cross coupling nonlinearities would also be eliminated during experimental periods. The H-vector control law would still be applicable for this new configuration. Author

N70-41119*# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

INERTIAL GYROSCOPE SYSTEM APPLICATION CONSIDERATIONS

Robert A. Booth and Richard R. Harlow, eds. Aug. 1969 94 p refs

(Contract NAS12-642)

(NASA-CR-113915; R-645) Avail: NTIS CSCL 17G

Problems and solutions are discussed related to the elements of a gyro system to help the system designer negotiate the specification for a gyro which reflects concern for both the system-imposed requirements and the realities of gyro construction. Although most of the discussion deals with inertial grade, single degree-of-freedom floated instruments, much of the material applies to any type of gyro that uses a spinning wheel. Author

N70-41156# Federal Aviation Administration, Washington, D.C. Flight Standards Service.

EVALUATION OF LOWER ILS MINIMUMS FOR LIGHT AIRCRAFT

Raymond W. Skinner and Frank Parr Jun. 1970 54 p

(AD-708294) Avail: NTIS CSCL 1/2

The evaluation included 120 ILS approaches flown under simulated IFR (hooded) conditions by 17 pilots in 6 types of light twin aircraft, to test the ability of pilots to align for landing or to execute a missed approach at minimums lower than 200 feet height and 1/2 mile visibility. A decision height of 100 feet was used during the entire project. Although only 80 percent of the scheduled landings were completed, pilots indicated that with normal runway lengths (5000 feet) most runs scheduled for landing could have been completed. The altimeter errors at the 100 foot decision height ranged from −80 to +45 feet, and seemed to cause the major problem. Missed aporoach data indicate that the missed approach obstacle clearance must be revised if minimums below 200 feet are to be approved for this pilot group. Author

N70-41207# National Aviation Facilities Experimental Center, Atlantic City, N.J.

ENGINEERING SURVEY AND ANALYSIS OF ENROUTE ATC RADAR/DISPLAY SYSTEM ERRORS Final Report, Jul. 1968 - Jun. 1969

Reuben H. Holliday Oct. 1970 43 p refs

(FAA-NA-70-14; FAA-RD-70-48) Avail: NTIS

En route radar (primary and secondary) range and azimuth accuracy data were collected from other projects and analyzed, along with theoretical considerations, to determine if the available accuracy data were adequate for assessing the position measuring performance of en route, air traffic control radar display systems. Author

N70-41271# National Aviation Facilities Experimental Center, Atlantic City, N.J.

TEST AND EVALUATION OF AN ADVANCED INTEGRATED LANDING SYSTEM FOR ALL-WEATHER LANDING Final Report, Aug. 1965 - Feb. 1970

Vincent L. Bencivenga Aug. 1970 148 p

(FAA-RD-70-28; FAA-NA-70-26) Avail: NTIS

Test and evaluation of an Advanced Integrated Landing System (AILS) is reported. The system incorporates a distance measuring equipment function, as well as a radar function for providing precision approach radar type monitoring of an approach. During the test program, AILS approaches were made in fixed-wing aircraft, both prop and jet, including short take-off and landing aircraft. Based on evaluation of the data collected, it was determined that the AISL is capable of providing air-derived space position information to the following accuracies, DME data to + or − 100 feet or 1 percent of distance, whichever is greater, azimuth angle data to + or − 0.05 deg 1 sigma, and elevation angle data to + or − 0.03 deg 1 sigma. The system is not adversely affected by overflying aircraft, and taxiing aircraft and/or other vehicles only affect performance when stopped so that they effectively shadow a transmitting antenna. Some minor system deficiencies exist for which proposed corrective measures are discussed. Author

N70-41325# Litton Systems Inc., Canoga Park, Calif. Aero Products Div.

FLIGHT EVALUATION OF INERTIAL/DME/DME SYSTEM Final Report

R. J. Holm May 1970 179 p

(Contract FAA-69-WA-2122)

(FAA-RD-70-24; FR-10) Avail: NTIS

A LTN-51 inertial navigation system augmented by two ARINC 568 digital DME's was flown in an FAA flight inspection aircraft for evaluation of updated inertial performance in the domestic area. The LTN-51 inertial computer received range inputs for two separate DME stations. The geographic fix of the two DME ranges was used to update the inertial system. Data were recorded automatically every four seconds and performance validated by comparison with flight inspection position calibration. The 150 successful flight hours covering the Western United Satates were achiaved in 2-1/2 months. Data show deviation was 1,102 feet, 50%; 1,233 feet, 68%, 2,530 feet, 95%; and 3,499 feet, 100% (mean percentile points). Terminal approaches were also demonstrated. Author

N70-41339# Bunker-Ramo Corp., Canoga Park, Calif. Defense Systems Div.

FLIGHT EVALUATION OF A PILOT-ASSIST STABILITY AUGMENTATION SYSTEM FOR A LIGHT AIRCRAFT Final Report

R. Welchi and D. Eldredge May 1970 125 p refs Sponsored jointly with FAA

(Contract F33615-69-C-1142)

(FAA-DS-70-14; H0191-0U10) Avail: NTIS

The utility of a light aircraft Pilot-Assist stability augmentation system in extracting the noninstrument qualified pilot from accidentally encountered instrument flight conditions is evaluated. Ten noninstrument rated pilots flew a predetermined course consisting of visual flight and instrument flight conditions. The aircraft was equipped with the Pilot-Assist system and a conventional stability augmentation system. The utility of the Pilot-Assist system was established through comparisons of continuous photographic data recordings of the airspeed, heading, bank angle, altitude, and altitude rate indicators on the aircraft's instrument panel, and through comparisons of pilot opinionnaire and detailed questionnaire data obtained for flights with both systems. The analysis of these data for both the Pilot-Assist system and the conventional stability augmentation system demonstrated that the utility of the Pilot-Assist system exceeded that of the conventional system. This relative utility was demonstrated both in terms of improvements in pilot performance and potential pilot acceptance. Author

N70-41493*# Massachusets Inst. of Tech., Cambridge. Man-Vehicle Lab.

DISPLAY RESEARCH, COLLISION WARNING SYSTEMS Final Report

Renwick E. Curry Jul. 1970 65 p refs
(Grant NGR-22-009-444)
(NASA-CR-113886) Avail: NTIS CSCL 17G

Display studies were conducted on an infrared Pilot Warning Indicator (PWI) system. The display is important not only from the point of view of the workload, but primarily because the pilot must quickly detect the target and evaluate the situation for the PWI system to work effectively. The feasibility of creating a stereophonic alarm to be used in the cockpit as an audio display was considered. The use of such a display would allow the pilot to turn his head immediately toward the target and start searching without having to refer to any visual instruments. Two experiments were performed with visual displays. The effect of the fields of view covered by the individual silicon detectors on a person's ability to locate targets was investigated. A moving-base simulator was constructed, and the time to detect targets using a head-up display, a panel mounted display, and a warning-only (buzzer) display tabulated.
E.M.C.

N70-41529# Federal Aviation Administration, Washington, D.C.
IMPLEMENTATION OF 50 kHz/Y CHANNELS FOR ILS/VOR/DME
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 21-28 (See N70-41526 23-02)
Avail: NTIS

The implementation of a 50 kHz frequency separation standard is considered with regard to the following questions: the extent to which the operations of general aviation and the air carriers might be adversely affected, the ability of the avionics industry to provide reasonably priced equipment in sufficient quantities, and whether or not compatible modes of operation will exist so as not to obsolete present equipment. The need for such channel splitting, as a result of a growing demand for navigational aids, is discussed. Specific recommendations concerning the manner of implementation and long range coordinate planning are presented. A proposed schedule of events up to 1973 is included.
P.A.B.

N70-41531# Federal Aviation Administration, Washington, D.C.
FLIGHT INSPECTION SYSTEM
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 37-39 (See N70-41526 23-02)
Avail: NTIS

The current status of the flight inspection program and its effectiveness are considered. Inspection and monitoring of the performance of navigation systems and of air traffic control facilities, through ground based facilities or through a combination of air and ground methods, are discussed. The need for facility accuracy and reliability is stressed. The establishment of a FAA-industry study group is noted.
P.A.B.

N70-41532# Federal Aviation Administration, Washington, D.C.
REDUCED TERMINAL IFR SEPARATION
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 41-47 (See N70-41526 23-02)
Avail: NTIS

Reduction of the present three mile IFR separation standards and/or the spacing between parallel runways, as a means of increasing capacity, is considered. The necessity for increased precision in establishing the desired flight paths and desired performance profiles, in adhering to these specifications, and in monitoring and taking corrective actions is noted. Plans and programs translating these objectives to subsystem functions are mentioned, along with program relating to system capacity and demand, multiple runway configurations, sequencing and spacing, and wake turbulence. Estimations of risk associated with the procedural changes, possible differences between theory and practice, the use of an airborne cockpit display to aid the pilot, segregation of traffic flow, and the need for guidance concerning the types of equipment needed to reduce runway separation are discussed.
P.A.B.

N70-41533# Federal Aviation Administration, Washington, D.C.
CONTROL ZONES FOR INSTRUMENT APPROACHES
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 49-52 (See N70-41526 23-02)
Avail: NTIS

The practicality and economic feasibility of establishing control zones at all locations with approved instrument approach procedures are considered. Possible safety benefits involved, the effect on users, and the possibility of other alternatives are discussed. Comments concerning weather reporting and communications requirements and costs, possible solutions to collision potential in terminal airspace, the need for education programs to increase safety, and a recommended restructuring of airspace categories are included.
P.A.B.

N70-41535# Federal Aviation Administration, Washington, D.C.
COLLISION AVOIDANCE
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 57-67 (See N70-41526 23-02)
Avail: NTIS

Systems available for collision prevention are considered as to the development and function of each, the user needs they satisfy, the impact they have on the air traffic control system, the implementation and operational problems they create, and the role the FAA should play regarding funding priority, standards, and regulatory action. The four areas discussed are: (1) conspicuity enhancement (CE); (2) pilot warning instrument (PWI); (3) collision avoidance system (CAS); and (4) intermittent positive control (IPC).
P.A.B.

N70-41536# Federal Aviation Administration, Washington, D.C.
INCREASED ENROUTE CAPACITY THROUGH INCREASED SECTORIZATION
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 69-72 (See N70-41526 23-02)
Avail: NTIS

The agency's plan to increase the number of control sectors is presented and discussed with regard to its viability, and possible alternative solutions for accommodating the growth in air traffic are considered. Basic deficiencies in enroute communications systems are mentioned, along with a possible new and improved system. Intermediate and long-range actions are suggested for increasing the controller's ability to handle increased traffic loads without decreasing sector size, with the ultimate aim of increasing the sector size as the controller's productivity increases. The determination of sectorization by mathematical analysis and the application of automation to the solution of air traffic problems are also discussed.
P.A.B.

N70-41538# Federal Aviation Administration, Washington, D.C.
ATC DATA ACQUISITION CONCEPT
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 79-95 (See N70-41526 23-02)
Avail: NTIS

Policy and plans for developing data acquisition capabilities are investigated in the areas of (1) the upgraded beacon system, (2) application of time frequency (TIF), and (3) the use of satellite based air traffic control systems. The current R and D program is divided into a mainstream development activity for upgrading the beacon system and into system analysis studies and feasibility experiments for the possible other system candidates. The time frame into which a satellite based system could be put into operation, the issues associated with T/F systems, DOD suggestions, airline requirements, and pilot opinions are discussed. Studies of the recommendations made by the Air Traffic Control Advisory Committee are considered with reference to the assumptions made in the systems model, the environments postulated, and the conclusions reached. A digital system of position determination, consisting of a receiver, a clock driven by a fairly precise oscillator, and an airborne pulse transmitter, is described, and its advantages noted.
P.A.B.

N70-41541# Federal Aviation Administration, Washington, D.C.
NEW GENERATION ILS
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 133 139 (See N70-41526 23-02)
Avail: NTIS

The urgency of a replacement for the current instrument landing system and the best method of an evolutionary transition are investigated. The FAA's future development and implementation plans are described, following the conclusion that a microwave system with different modulation techniques will be required. Comments are presented concerning the development of a precision guidance system concept for approach and landing and of an associated signal structure, airline requirements for a replacement ILS, military developments in microwave ILS, development needs in cockpit instrumentation, and management of the transition phase. Implementation and use of conventional ILS facilities are discussed, including delays in implementation of VHF Category 3A ground facilities, the uses to be made of Category 3A ILS when available, and the compatibility of microwave scanning beam ILS accuracy with 2500 ft runway separation. Specific recommendations include immediate provision of Category 3A capability at an operational airport, work toward agreement on a single microwave ILS signal format applicable for all classes of service, and development of operational procedures to be used with the scanning beam ILS. P.A.B.

N70-41722# Naval Research Lab., Washington, D.C. Electromagnetic Propagation Branch.
ACCURACY STUDIES OF THE DIFFERENTIAL OMEGA TECHNIQUE Interim Report
K. Luken, J. W. Brogden, and W. D. Meyers 29 Jun. 1970 40 p refs
(AD-709555; NRL-7102) Avail: NTIS CSCL 17/7

The Omega navigation system is a vlf radio navigation system which will provide worldwide coverage with an accuracy of 1 to 2 mi or better using eight transmitting stations. This absolute accuracy is limited by the stability of the phase velocity and the ability to predict it. The relative accuracy of the Omega system, the determination of the distance between two receivers, is much better than the geographic accuracy of 1 or 2 mi because the propagation variations over a comparatively small area are correlated. The report gives the results of the relative accuracy of the Omega system, based on a study which was made in the Washington area. Relative accuracies of 350 yd or better were obtained. The maximum receiver separation was 40 mi. Two type AN/WRN-2(XN-1) Omega monitor receivers were modified to obtain the greatest accuracy possible with this equipment. The data obtained with these equipments on relative Omega in the Washington area showed that a significant portion of the error was instrumental, and if further studies are conducted, improved equipment should be obtained. Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N70-40451 California Inst. of Tech., Pasadena.
REFLECTION AND TRANSMISSION FUNCTIONS IN REACTOR PHYSICS
Wayne Wallace Pfeiffer (Ph.D. Thesis) 1969 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-19592

Existing response function calculations are summarized and extended by combining the invariant imbedding and functional equations. For deep-penetration shielding problems in slab geometry, this combined response function approach is shown to be more efficient than conventional Monte Carlo or discrete ordinates techniques. The response function approach is also shown to be efficient for a criticality search in slab geometry. Invariant imbedding equations are derived, but not solved, in finite cylindrical geometry. The feasibility of performing response function experiments to obtain cross-section and criticality information is examined. The envisioned experimental set-up is described and calculations are carried out to verify the analytical procedures, with particular emphasis on the propagation of errors. Dissert. Abstr.

N70-40496 National Lending Library for Science and Technology, Boston Spa (England).
DETERMINATION OF FISSION PRODUCTS IN COOLANT GAS WITH DELAYED NEUTRON MEASUREMENT
J. Moravek et al 22 Jun. 1970 17 p refs Transl. into ENGLISH from Bull. EGU (Czechoslovakia), no. 3/4, 1968 p 51 – 56
(NLL-CE-Trans-5296-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The method for the detection of delayed neutrons is evaluated with regard to the measurement of the concentration of fission products in the primary circuit. A method for calculating the optimum time for the transfer of the sample from the reactor to the measuring area is indicated as well as a method for calculating the sensitivity of the system. An example is given in which the method and the calculation of the sensitivity were carried out for an actual nuclear reactor and for factual parameters of the coolant in the primary circuit. Author

N70-40497 National Lending Library for Science and Technology, Boston Spa (England).
INCIDENCE OF CAVITATION PROBLEMS IN SODIUM COOLED REACTORS
J. P. Duport et al 8 Jun. 1970 20 p Transl. into ENGLISH from French report
(NLL-EE-Trans-1920-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The phenomena of cavitation in liquids and the causative hydrodynamic circumstances are reviewed and the possible consequences of cavitation in sodium cooled reactors are analyzed. Particular emphasis is given to cavitation problems caused by the delivery control in the bottom of assemblies. The principles of constructive solutions to eliminate the risks of cavitation damage are discussed. Author

N70-41092*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
PRELIMINARY THERMAL ANALYSIS OF AN AERODYNAMICALLY SHAPED HEAT SOURCE FOR USE WITH THE ISOTOPE BRAYTON SPACE POWER SYSTEM
Raymond K. Burns Sep. 1970 38 p
(NASA-TM-X-52891) Avail: NTIS CSCL 18N

A two-dimensional thermal analysis was used to demonstrate the thermal advantage of using an isotope heat source aerodynamically shaped for predictable orientation during individual heat source atmospheric reentry. One side of the heat source, designed to lead during reentry, is insulated for thermal protection. The opposite side (uninsulated) is used as a heat transfer path during power system operation. This approach is intended to eliminate the conflict between reentry and steady state operation thermal requirements which exist for the present Pioneer-type design being considered for use with the Brayton power system. Author

N70-41276*# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
CONCEPTUAL DESIGN STUDY OF A NUCLEAR BRAYTON

TURBOALTERNATOR-COMPRESSOR, PHASES 1 - 3 Final Report
R. O. Brooks, ed. [1970] 543 p refs
(Contract NAS3-13449)
(NASA-CR-113925; GESP-493) Avail: NTIS CSCL 18N

The Brayton TAC study was conducted with a number of component designs and lubrication systems as candidates for selection. It was concluded that the radial in-flow turbine, centrifugal compressor, and 1200 Hz Rice - Lundell alternator, mounted on gas lubricated bearings met the requirements. Slight modifications were found to be necessary for the low temperature application and the modified requirements necessitated additional geometric changes and the 400 Hz Lundell alternator was selected. The principal features of the TAC include a titanium alloy compressor wheel with back-swept blades to obtain maximum efficiency. The alternator rotor is of bimetallic construction with 4340 and Inconel 718 to be bonded by HIP welding. Cooling is provided for the pole face losses by circulation of the working fluid through the gap and stack to a heat exchanger cooled by oil along the periphery of the stator. The reference voltage is 240 (L-N) with reconnectability to 480 volts. The insulation systems considered included high temperature ceramic materials previously developed by NASA and inorganic insulation for lower temperature application. Author

N70-41335*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIATION HAZARD FROM BACKFLOW OF FISSION FRAGMENTS FROM THE PLUME OF A GAS-CORE NUCLEAR ROCKET
Charles C. Masser Jan. 1970 15 p refs Presented at the Symp. on Res. on Uranium Plasmas and Their Technol. Appl., Gainesville, Fla., 7 - 10 Jan. 1970; Sponsored by NASA
(NASA-TM-X-52743) Avail: NTIS CSCL 21F

Analytical calculations are performed to determine the particle flux that leaves a rocket plume in a vacuum and strikes the rocket forward of the nozzle. The rocket plume is generated by the products of a gas-core nuclear reactor and consists of hydrogen, uranium, and fission fragments. The backflow flux is determined by the number of particles that leave the continuum of the plume and strike the rocket without experiencing any particle collisions. A percentage of these particles that strike the rocket are fission fragments and the radiation dose to the crew is calculated. A total of 1.68 pounds of fission fragments are formed from a gas-core rocket that produces one million pounds of thrust at a specific impulse of 1500 seconds for a propellant consumption of one million pounds. Of the 1.68 pounds of fission fragments only 0.42×10 to the minus 8th power pound flow back from the plume. And only 0.66×10 to the minus 10th power pound of fission fragments strike the rocket. This weight of fission fragments causes a total integrated dose of less than 1.3×10 to the minus 4th power rad to the crew, which is well below acceptable levels. Author

N70-41396 National Lending Library for Science and Technology, Boston Spa (England).
FUEL HANDLING AND SPECIAL HANDLING OPERATIONS
C. Boulinier 2 May 1969 29 p Transl. into ENGLISH from Bull. Inform. Sci. Tech. (Paris), no. 138, Jun. 1969 p 75 - 78
(NLL-RISLEY-Trans-1876-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

The handling operations involved in inserting and withdrawing, transporting, storage, and maintenance of demountable reactor components are described. The handling operations are divided into two major categories: the handling of elements related to the ore, and those relating to equipment and fixtures. Radiological and operational safety are discussed. F.O.S.

N70-41397# Oak Ridge National Lab., Tenn.
EVALUATION OF THORIUM-URANIUM ALLOYS FOR THE UNCLAD-METAL BREEDER REACTOR
G. L. Copeland Jun. 1970 74 p refs
(Contract W-7405-eng-26)
(ORNL-4557) Avail: NTIS

The literature on thorium-uranium alloys was surveyed for information relative to the use of a Th-20% U alloy for the fuel element for the Unclad-Metal Breeder Reactor. The applicable physical, fabrication, and irradiation properties for a range of thorium-uranium alloy compositions are summarized. Several methods are available for manufacturing the fuel element, but the feasibility of most of the proposed methods has not been demonstrated for this alloy. Limited data indicated that the alloy will have the irradiation stability to reach the design life of 33,000 MWd/metric ton at < or = to 650 C. The distribution of the phases in the alloy was determined by the fabrication technique and will influence the properties of the fuel element. Compatibility of the fuel with the sodium coolant was not considered for this report. Author (NSA)

N70-41472# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
PHYSICS VERIFICATION PROGRAM, PART 3, TASK 4 Quarterly Technical Report, Jan. - Mar. 1970
M. N. Baldwin and M. E. Stern Jun. 1970 13 p refs
(Contract AT(30-1)-3647)
(BAW-3647-17-Pt-3) Avail: NTIS

Results of a series of experiments to measure the effects of lattice heterogeneities are presented. The water moderated critical assembly, fuel rods, and poison rods are described. Unclad Pyrex glass rods, aluminum-clad Vicor glass rods, aluminum-clad Al2O3 rods, and water holes were spaced on selected patterns in an otherwise uniform clean lattice and their effects on reactivity and power shape were determined. NSA

N70-41550# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTOR ENGINEERING DEVELOPMENT. REACTOR ENVIRONMENTAL EFFECTS ON SIGNAL CABLES Quarterly Report, Jan. - Mar. 1970
J. L. Stringer Apr. 1970 35 p refs
(Contract AT(45-1)-1830)
(BNWL-1325-2) Avail: NTIS

The experimental investigations of this program are to: (1) provide a better understanding of radiation induced currents so that maximum limits can be determined for the magnitude of the current induced in a specific radiation environment; (2) measure and study the noise generated in the metal oxide insulator used in signal cables as a function of radiation, temperature and applied voltage both as an aid in understanding the generation mechanism and in determining the noise limit for instrumentation applications; and (3) provide bulk insulator conductivity data as a function of radiation and temperature for other powder insulation materials presently available in signal cables for engineering design. Research progress is reported. Author (NSA)

N70-41563# Los Alamos Scientific Lab., N.Mex.
THE UC-ZrC-C SYSTEM
Oezel Inanc 24 Apr. 1970 46 p refs Transl. into ENGLISH from the German Rept.
(LA-4157-TR; JUL-516-RW) Avail: NTIS

Equipment for measurement of heat capacities and heats of transition in the temperature range from 10 to 450 K is described. A special feature of the apparatus is the use of automatic devices for recording the experimental data on punched tape, which is then processed by computer. Results of measurements on uranium carbides (UC, UC 1.91 and U2C2) and uranium nitrides (UN1.01, UN1.59, and UN1.73) are summarized. Author (NSA)

N70-41606# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
THE EFFECT OF THERMAL MECHANICAL TREATMENTS ON THE TENSILE STRENGTH OF 19-9DL AND 12R72HV AUSTENITIC STAINLESS STEELS
C. G. Collins Jun. 1970 29 p refs
(Contract AT(40-1)-2847)
(GEVP-743) Avail: NTIS

Studies directed to the development of the 19-9DL and 12R72HV alloys as fuel cladding alloys for fast breeder reactors are described. The strength and ductility properties of these alloys attained with different thermal mechanical treatments were assessed by tensile tests in the 550 to 760 C temperature range and the results were used to select three basic treatments for investigation under irradiation conditions. Author (NSA)

N70-41635# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
POSTIRRADIATION EXAMINATION AND EVALUATION OF TUNGSTEN-URANIA CERMETS
A. E. Richt, M. M. Martin, and W. R. Martin Jun. 1970 46 p refs
(Contract W-7405-eng-26)
(ORNL-4569) Avail: NTIS

The postirradiation evaluation of tungsten-urania and tungsten-urania-thoria dispersions irradiated in the Oak Ridge Research Reactor was completed. Eight capsules were irradiated at 1500 to 1730 C and with a burnup of approximately 1.4×10 to the 20th power fission/cu cm of the composite core. These capsules were irradiated to study the effect of type and magnitude of voids in reducing swelling of W-UO2 and W-UO2-ThO2 cermets clad with a W-Re-Mo alloy. All phases of the postirradiation examination program including burnup determination, dimensional measurements, and metallographic examination were completed. The maximum increase in diameter of all eight pins ranged between 1.3 and 6.7%. Analysis of the irradiation data indicated void deployment to be less important than the total void content. End plenum void volume may have an upper effective limit of about 14%. Failure of one fuel capsule during irradiation may have been premature and caused by excessive mass transfer between fuel and cladding. Author (NSA)

N70-41686# Battelle-Northwest, Richland, Wash. Metallurgy and Ceramics Dept.
EXPERIENCE WITH CONTROL ROD SEALS USED ON SODIUM-COOLED REACTORS
N. R. Gordon Jun. 1970 236 p refs
(Contract AT(45-1)-1830)
(BNWL-1387) Avail: NTIS

A survey was made to determine the state-of-the-technology on elastomeric reactor seals to provide a better background for design of FFTF seals. The survey revealed only two applications of elastomeric seals within a reactor. Information on silicone rubber and ethylene propylene rubber indicate that they should be considered for some of the penetration seals on the FFTF. Author (NSA)

N70-41704# Oak Ridge National Lab., Tenn.
ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM Bimonthly Report, Mar. – Apr. 1970
William B. Cottrell Jun. 1970 178 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2984) Avail: NTIS

Much of the work is in general support of water-cooled power reactor technology, including LOFT and industry programs, and reflects current safety problems, such as measurements of prompt fuel element failure phenomena and the efficacy of containment-spray and pool-suppression systems for fission-product removal. Also included are studies on the release and behavior of accident released fission products, as well as the removal of these fission products and aerosols from gas streams by filters and adsorbers. Several projects are also conducted in support of the high-temperature gas-cooled reactor and liquid-metal fast breeder reactor programs. Other major projects include studies of primary piping and steel pressure-vessel technology. Experimental work relative to pressure-vessel technology includes investigations of the attachment of nozzles to shells and the implementation of joint AEC-PVRC programs on heavy-section steel technology and nuclear piping, pumps, and valves. Several of the projects are directly related to the AEC's standards program. Author (NSA)

N70-41793# Idaho Nuclear Corp., Idaho Falls.
SPERT PROJECT Annual Report, Oct. 1968 – Sep. 1969
T. G. Taxelius, ed. Jun. 1970 211 p refs
(Contract AT(10-1)-1230)
(IN-1370) Avail: NTIS

Research is reported in a program to determine the thresholds and gross consequences of failure of reactor fuels. The fuels are tested by subjecting them to transient overpower conditions that are typical of reactivity accidents in an operating power reactor. Results are presented for tests conducted on: (1) individual unirradiated rods manufactured to standards of commercial boiling water reactor fuels; (2) individual unirradiated rods containing pellet fuel specifically designed for the test program; (3) irradiated GEX-type pellet rods with burnups in the range of 3000 to 3300 MWd/MTM; (4) plutonium recycle fuels in the form of mixed oxides. (5) individual, waterlogged UO2 fuel rods; and (6) glass-clad UO2 pellet rods. D.L.G.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N70-40428 Utah Univ., Salt Lake City.
EMPIRICAL GEOMETRY
Shirley Neil Rasband (Ph.D. Thesis) 1969 66 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-18662

Empirical foundations for concepts of length and time are examined within the framework of a simple concrete model. The model, based on an observer with a flashlight and a clock, is used in order to investigate the extent to which geometry can be defined as correlations among such laboratory observables. Time intervals on a master clock between emission and reception of multiply reflected light beams provide input data. Remote time is defined through reception of electromagnetic pulses, and a remote clock may be said to exist when it produces a sequence of events in agreement with this definition. A democratic definition of distance between remote pairs of particles is given which operationally distinguishes neither. A quantity called the difference parameter arises intrinsically in the formal structure as a consequence of the definitions and allows one to define preferred local reference systems. An empirically observable space-time interval is defined. The metric (and its dimensionality) are empirical. Dissert. Abstr.

N70-40429 California Univ., San Diego.
THE EFFECT ON RADIATIVE TRANSFER ON ACOUSTIC DISTURBANCES IN GASES
Eugene Pierre de Plomb (Ph.D. Thesis) 1969 145 p

Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-19697

A brief presentation of the basic ideas and equations of radiation-acoustics is followed by an analysis of problems illustrating the effect of radiative transfer upon acoustic disturbances in gases. The decay of perturbations in a radiating gas is analyzed, and calculations are performed to describe the propagation of an acoustic wave which absorbs energy from an external radiation flux applied instantaneously at the gas boundary. Two analyses are carried out: (1) a perturbation calculation with the radiation affecting the acoustic wave only through second-order terms; (2) an analysis for the transparent limit with the radiation producing a first-order interaction with the acoustic wave. A feasibility study is then presented to show that the amplification of acoustic waves by external radiation can be measured in the laboratory. Dissert. Abstr.

N70-40566# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.

FLUCTUATING TURBULENT STRESSES IN THE NOISE-PRODUCING REGION OF A JET, PART 2

Ian S. F. Jones Mar. 1968 36 p refs

(RR-10-Pt-2) Avail: NTIS

Measurements are presented of the wave-number frequency spectrum of a fluctuating Reynolds stress in the mixing layer of a jet. From these measurements the influence of retarded time in acoustic radiation from a jet can be assessed. Static pressure fluctuations have also been measured and are included for comparison with the Reynolds stresses. Author

N70-40650# Technische Univ., Berlin (West Germany).

SOUND PROPAGATION IN A CHANNEL WITH PERIODIC WALL STRUCTURE AND LATERAL COUPLING IN THE FIELDS BEHIND THE WALL [SCHALLAUSBREITUNG IM KANAL MIT PERIODISCHER WANDSTRUKTUR UNTER BERUECKSICHTIGUNG SEITLICHER KOPPLUNGEN IN DEN FELDERN HINTER DER WAND]

Ulrich Kurze (Ph.D. Thesis) 1968 83 p refs In GERMAN

Avail: NTIS

Sound attenuation is investigated in periodic structures in which gas flow is negligible. The characteristics of the periodic structure are considered with respect to the periodic boundary conditions for the sound field in the channel. The effect of different types of absorption material on bandpass width is emphasized. Transl. by R.B.

N70-40658*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HYDROGEN REMOVAL BY CRYODEPOSITS

Jerry D. Smith Washington Oct. 1970 30 p refs

(NASA-TM-X-2104; E-5693) Avail: NTIS CSCL 20L

Cryotrapping (or cryosorption) of hydrogen by other gases which readily condense on cryogenic surfaces is a cryopumping process not well understood. The most likely mechanism is shown to be physical adsorption on the interior surfaces of a microporous frost of condensables, followed by at least partial filling of the pores with liquid or solid hydrogen depending on surface temperature. Supporting observations are drawn from previous cryotrapping experiments and diffraction studies of condensates. Some qualitative guidelines for the practical use of the effect are given. Most of them are based on creating as porous a frost as possible. Author

N70-40775# Catholic Univ. of America, Washington, D.C. Dept. of Physics.

ACOUSTIC WAVES TRANSMITTED THROUGH LIQUID CYLINDERS

D. Brill and Herbert M. Uberall Jan. 1970 65 p refs

(Contract N00014-69-A-0432; Proj. Themis)

(AD-708405; Rept-70-1) Avail: NTIS CSCL 20/1

The acoustic field of a plane wave incident on an elastic cylinder may be decomposed into two parts, one having the form of circumferential waves propagating around the cylinder, the other one obeying in the high-frequency limit the laws of geometrical optics. For the simpler case of a liquid cylinder, the geometrical part is studied here, and is shown to consist of the specularly reflected wave, and of transmitted waves which traverse the cylinder along a secant, possibly undergoing one or more internal reflections in addition. Author (TAB)

N70-40824# ARO, Inc., Arnold Air Force Station, Tenn.

INFRARED REFLECTANCE OF CO2 CRYODEPOSITS Final Report Jul. 1968 - Sep. 1969

B. E. Wood, A. M. Smith, B. A. Seiber et al AEDC Jul. 1970 42 p refs

(Contract F40600-71-C-0002)

(AD-708509; AEDC-TR-70-108) Avail: NTIS CSCL 7/4

In-situ reflectance measurements were made for carbon dioxide (CO2) frosts formed on liquid-nitrogen-cooled substrates. The data were obtained spectrally in the wavelength range from 0.5 to 12.0 microns using an infrared integrating sphere. These measurements were made using the hemispherical-angular technique and resulted in the determination of the absolute reflectance. The properties of the CO2 frosts were studied by forming them on black epoxy paint and polished stainless steel substrates. The CO2 frosts were found to exhibit an anomalous dispersion reflectance peak at 4.3 microns which was shown to be a very sensitive indication of the presence of solid CO2. In addition, it was found that CO2 scatters short wavelength radiation significantly and is semitransparent for much of the wavelength range between 2.0 and 12.0 microns. The application of these results to other problems associated with cryogenically cooled surfaces is discussed. Author (TAB)

N70-40990# Naval Post Graduate School, Monterey, Calif.

A STUDY OF THE TWO-FLOW MODEL OF LIGHT IN THE SEA

Marvin Howard Crisp (M.S. Thesis) Jun. 1970 58 p refs

(AD-709107) Avail: NTIS CSCL 8/10

The principles of invariance form the foundation of the study of irradiance fields in the sea. By review of the existing theory, it is shown how these principles may be applied to imbedded layers to derive complete reflectance and transmittance factors for the containing layer. These complete factors in turn yield the desired irradiance fields. They are also used to develop local invariance principles and the associated local transmittance and reflectance factors. Differential equations for reflectance and transmittance are developed, based on these local factors, and in turn are used in numerical computations of the reflectance and transmittance factors for arbitrarily deep layers of water. Boundary conditions on the upper and lower surfaces of the layer are chosen so that the complete reflectance and the complete transmittance factors generate the irradiances of the appropriate light field. Numerical computations are based on real data for eight natural media. To study the dependence of the light field on extreme cases of the optical properties, two hypothetical cases are also considered. Author (TAB)

N70-41004# Naval Postgraduate School, Monterey, Calif.

INTERACTION OF TWO SOUND BEAMS IN WATER

Gerald Albert Fulk Oct. 1969 56 p refs

(AD-709093) Avail: NTIS CSCL 20/1

Modern sonars are large in size. This is a result of several factors connected with operation at low frequencies. Non-linear interaction of two high-frequency sound beams in water may provide a source of low-frequency sound without the use of large transducers. The theory of interaction of two plane waves is reviewed.

and conversion efficiency is studied. Early experimental work is also reviewed. To provide new experimental data, primary sources of 385 kHz and 435 kHz are mounted side-by-side in an anechoic tank. The sound field between the parallel beams is explored. A difference-frequency signal is detected, but its amplitude is found to be greater than the theoretical value. Non-linearities in the receiving hydrophone are suspected as contributing to the 50-kHz signal level. Various techniques for eliminating psuedo-sound are discussed, and recommendations for further study are presented. Author (TAB)

N70-41052# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Electrical Engineering.
NARROW BAND SHOT NOISE AND GAUSSIANITY
Technical Phase Report
Athanasios Papoulis Griffiss AFB, N.Y. RADC Jun. 1970 30 p refs
(Contract F30602-69-C-0331)
(AD-709215; PIBEE-69-011; RADC-TR-70-97) Avail. NTIS CSCL 20/1

Bounds on the deviation from Gaussianity of a narrowband shot noise are established. Author (TAB)

N70-41113# Joint Publications Research Service, Washington, D.C.
USE OF ALBEDOMETER IN DETERMINING OPTICAL COEFFICIENTS OF TECHNICAL MATERIALS
B. A. Grigoryev et al 16 Sep. 1970 9 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Minsk), v. 1, no. 1, 1958 p 34-40
(JPRS-51385) Avail: NTIS

Details are given on the use of an albedometer to determine the optical coefficients of technical materials having reflection and transmission coefficients close to those ideally scattered under conditions of direct normal irradiation from the sun. When using this technique, the irradiated surface should be normal to the incident solar radiation, with the receiving surface of the albedometer parallel to the irradiated surface. The albedometer is installed so that it moves in a zone where the variations in angular coefficients are strongest for materials having scattered reflection or transmission. Author

N70-41129*# Geological Survey, Washington, D.C.
THE EFFECT OF ULTRAVIOLET RADIATION ON THE INTENSITY OF LUMINESCENCE
David L. Daniels Jun. 1966 15 p *Its* Tech. Lett. NASA No. 36
(NASA Order R-146-09-020-006)
(NASA-CR-76287) Avail: NTIS CSCL 20F

Samples of scapolite, a luminescent mineral, were irradiated continuously with light from a mercury vapor lamp for periods ranging from 1 hr to as long as 9 days to study the effects of prolonged ultraviolet radiation on luminescing surfaces. Part of the surface of the samples was masked by a sheet of non-luminescing black painted brass serving as a basis for evaluating the measurement of output intensity to luminescence and to spurious fluctuations in power and instrument sensitivity. A diagram of the equipment used, with a special sample holder that was constructed, is included. Plots of the intensity measurements as a function of time for three runs are given. Results indicate that no significant change in luminescent intensity due to prolonged exposure to ultraviolet radiation occurs. Author

N70-41134# Syracuse Univ., N.Y. Dept. of Physics.
QUANTIZATION OF THE GRAVITATIONAL FIELD Final Report, 21 Oct. 1964 - 21 Sep. 1969
Peter G. Bergmann Wright-Patterson AFB, Ohio ARL Apr. 1970 427 p refs
(Contract AF 33(615)-2238)
(AD-709370; ARL-70-0066) Avail: NTIS CSCL 20/10

Contents: Radiation and observables; Physics and geometry; Spherically symmetric gravitational fields; Hamilton-Jacobi and Schrodinger theory in theories with first-class Hamiltonian constraints; Foundations research in physics, Delaware seminar in the foundation of physics; The quantum state vector and physical reality; Comments on the scalar-tensor theory; Status of canonical quantization; The sandwich conjecture; Decomposition of the Lorentz Matrix into skew symmetric tensors; The tail of a gravitational wave; Hamiltonian formalism on characteristic surfaces; Relativistic thermodynamics; The self scattering of a gravitational wave; Noether equations and conservation laws. TAB

N70-41167# Syracuse Univ., N.Y. Dept. of Physics.
COHERENT STATES AND INDEFINITE METRIC: APPLICATIONS TO THE FREE ELECTROMAGNETIC AND GRAVITATIONAL FIELDS
Jagannathan Gomatam Aug. 1970 22 p refs Sponsored by NSF
Avail: Issuing Activity

The coherent states are constructed within the framework of an indefinite metric linear vector space. It is found that these states have positive definite norm and are eigenstates of the annihilation operator. The theory is then applied to the free electromagnetic field and the linearized free gravitational field in the Gupta formulation. The coherent states restricted by the weak subsidiary condition decompose into the usual coherent states involving only the physical degrees of freedom and an orthogonal vector of vanishing norm. Author

N70-41200*# Stanford Univ., Calif. Microwave Lab.
TUNABLE OPTICAL PARAMETRIC OSCILLATORS
Stephen E. Harris Mar. 1970 92 p refs
(Grant NGR-05-020-103; Contract F19628-67-C-0038)
(NASA-CR-113891; AD-705193; SU-ML-1788; AFCRL-70-0165; SR-1) Avail: NTIS CSCL 20F

The paper reviews progress on tunable optical parametric oscillators. Topics considered include: parametric amplification of Gaussian beams; threshold; tuning techniques, spectral output, and stability; saturation and power output; spontaneous parametric emission; nonlinear materials; and far infrared generation. Author (TAB)

N70-41674# Stanford Univ., Calif. Inst. for Plasma Research.
LAGRANGIAN DERIVATION OF NONLINEAR WAVE COUPLING COEFFICIENTS
J. J. Galloway Apr. 1970 37 p refs
(Contract AT(04-3)-799; Grant NSF GK-16717)
(SU-IPR-362) Avail: NTIS

A concise method is developed for obtaining the mode coupling coefficient for weak nonlinear interaction of waves or oscillations. It applies to any continuous medium which can be described by a Lagrangian density, and is based on an extension, via Hamilton's principle, of the Manley-Rowe type relationships for such a system. The coupling coefficient is calculated by means of that part of the Lagrangian density that describes the lowest-order nonlinear behavior of the system, and the process uses as input the relationships between wave parameters obtained from the standard linear or small-signal theory. The approach is intended, through its simplicity and close connection with Lagrangian mechanics, to offer improved insight, and a saving in algebraic manipulation for complicated problems. Author (NSA)

N70-41726# Dayton Univ. Research Inst., Ohio.
THE RECENT DEVELOPMENT OF PERMANENT MAGNET MATERIALS CONTAINING RARE EARTH METALS

Technical Report, 1 Jan. – 31 Oct. 1969
Karl J. Strnat Wright-Patterson AFB, Ohio AFML Jun. 1970 33 p refs
(Contract F33615-69-C-1172)
(AD-709687; AFML-TR-69-299) Avail: NTIS CSCL 20/3

The prospect that permanent magnets with previously unattainable coercivities and energy products might be made from cobalt-rare earth alloys has caused intense research efforts in the last three years. Alternative ways of preparing magnets from powders and by casting were demonstrated in several laboratories. (BH)max of about 20MGOe and (M)H(c) > 25000 Oe have been achieved with SmCo5, and the development of manufacturing processes for magnets made from this alloy has begun. The paper reviews the basic concepts, properties of the alloys of interest and the physical factors influencing the coercive force. Approaches to alloy, powder and magnet fabrication are discussed, with their merits and drawbacks; also problems incurred in the materials development and their possible solutions. Application areas are reviewed and some economic factors considered. It is concluded that the RCo5 magnets are indeed beginning to live up to their promise, but that more materials research, process development and circuit redesign are needed if their potential is to be fully utilized.
Author (TAB)

N70-41779*# General Dynamics/Fort Worth, Tex.
STUDY OF CRYOGENIC FLUID MIXING TECHNIQUES. VOLUME 1: LARGE-SCALE EXPERIMENTAL MIXING INVESTIGATIONS AND LIQUID-OXYGEN MIXER DESIGN Final Report
J. R. Van Hook and L. J. Poth 15 Sep. 1970 163 p refs
(Contract NAS8-24882)
(NASA-CR-113897; FZA-450-1-Vol-1) Avail: NTIS CSCL 20M

The validity of scaling small-scale test data for use in designing liquid-hydrogen mixer systems for full-scale tanks was verified through use of a test tank intermediate in size between the previous small-scale tank and the full-scale tanks of spacecraft. The experimental mixing investigation involved mixing in a large-scale (10-foot-diameter, 20-foot-long) stratified tank with nonpressurized water used as the test fluid. Tests were conducted to duplicate the range of the previous small-scale test parameters. The data obtained consist of temperature histories in the tank during mixing and a limited amount of jet motion data. These data were used to make correlations of mixing time and the effect of buoyancy on mixing. The jet motion data were used to check the time required for the jet to move from the nozzle exit to the liquid surface. The large-scale data correlation of the bouyancy effect indicated that the delay in mixing time due to bouyancy is relatively small for conditions simulating low-g environments.
Author

N70-41780*# General Dynamics/Fort Worth, Tex.
STUDY OF CRYOGENIC FLUID MIXING TECHNIQUES. VOLUME 2: LARGE-SCALE MIXING DATA Final Report, Jul. 1969 – Jul. 1970
J. R. Van Hook 15 Sep. 1970 245 p ref
(Contract NAS8-24882)
(NASA-CR-113914; FZA-450-2-Vol-2) Avail: NTIS CSCL 20M

The experimental mixing investigation involved mixing in a large-scale (10-foot-diameter, 20-foot-long) stratified tank with nonpressurized water used as the test fluid. Tests were conducted to duplicate the range of the previous small-scale test parameters. The data obtained consist of temperature histories in the tank during mixing. The basic mixing data and the preliminary dimensionless correlations made for each of the 52 tests run are presented.
Author

N70-41781*# General Dynamics/Fort Worth, Tex.
STUDY OF CRYOGENIC FLUID MIXING TECHNIQUES. VOLUME 3: COMPUTER PROCEDURE FOR THE PREDICTION OF STRATIFICATION IN SUPER CRITICAL OXYGEN TANKS Final Report, Jul. 1969 – Jul. 1970
L. J. Poth 15 Sep. 1970 83 p refs
(Contract NAS8-24882)
(NASA-CR-113913; FZA-450-3-Vol-3) Avail: NTIS CSCL 20M

The computer procedure used to predict the thermodynamic state of supercritical oxygen is described. The procedure is used to predict the transient pressure, density, temperature, and mass of supercritical oxygen stored under a zero-gravity environment in a spherical tank. Both temperature-stratified and -mixed cases were analyzed. In the stratified case, only radial variations in the thermodynamic state are considered. For the mixed case (thermodynamic equilibrium), the thermodynamic state of the stored oxygen is established by overall mass and energy conservation along with an appropriate equation of state. These governing equations were solved in an approximate fashion by the use of a finite-element, numerical solution. The description of the computer program includes such information as typical error diagnosis, sample problem input and output data, and the computer program listing.
Author

N70-41786# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
EXPERIMENTAL METHODS FOR THE OBSERVATION OF OPTICAL HETERODYNE DETECTION
William McMartin and Robert Mauro Jul. 1970 17 p
(AD-709596; ECOM-3311) Avail: NTIS CSCL 17/8

A theoretical development along with experimental results are presented which demonstrate that in optical heterodyne work beam parallelism must be maintained to an accuracy exceeding (theta approximately equal to lambda over D) while beam detector orientation is relatively unimportant.
Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N70-40411 Florida State Univ., Tallahassee.
THE NUCLEAR STRUCTURE OF Rb 86
John W. Dawson (Ph.D. Thesis) 1969 157 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-17668

The reactions Rb-85 (d,p)Rb-86 and Rb-87 (d,t)Rb-86 were initiated in isotopically enriched targets with 12 MeV deuterons from a tandem accelerator. The reaction products were analyzed and detected at a number of angles with a magnetic spectrograph. Q-values, excitation energies, and cross sections for levels in Rb-86 below 2.5 MeV were determined. Proton angular distributions were analyzed by means of distorted-wave Born-approximation stripping theory. The low lying excited states of Rb-86 populated by primary and secondary gamma ray transitions from the Rb-85 (neutron, photon)Rb-86 thermal neutron capture reaction were studied. Ge(Li) detectors were used in the gamma ray energy and cross section measurements. Data from the (d,p), (d,t), and high energy (neutron, photon) measurements were combined with the low energy secondary gamma ray measurements and a level and decay scheme was proposed for excited states below 1.5 MeV. The energy level spectrum emerging from this work was used to determine the applicability of the odd group shell model to Rb-86.
Dissert. Abstr.

N70-40418*# Pittsburgh Univ., Pa. Dept. of Physics.
CONFIGURATION SPACE THREE-BODY SCATTERING THEORY
E. Gerjuoy [1970] 10 p refs
(Grant NGR-30-011-035; Contract DA-31-124-ARO(D)-440)
(NASA-CR-112667) Avail: NTIS CSCL 20H

Results are quoted for the physical three-body transition operator yielding the volume-independent three-body reaction coefficient. The three-body elastic scattering rate is computed when three initially free independently moving particles collide under the influence of short range forces. Author

N70-40448# Naval Research Lab., Washington, D.C.
AN ATTEMPT TO DETECT THE LYMAN ALPHA RADIATION FROM POSITRONIUM Final Report
L. W. Fagg 24 Jun. 1970 20 p refs
(AD-709077; NRL-MR-2143) Avail: NTIS CSCL 20/8

The report describes an unsuccessful attempt to detect the Lyman-alpha radiation from the positronium atom. Pertinent aspects of positronium formation, Lyman-alpha emission, and subsequent decay are briefly introduced. A description of the experimental apparatus and procedure is presented. The results are discussed along with suggestions for improvements for future attempts. Author (TAB)

N70-40467 Washington Univ., Seattle.
STORAGE AND RADIATIVE COOLING OF LIGHT ION GASES IN RADIO-FREQUENCY QUADRUPOLE TRAPS
David Arthur Church (Ph.D. Thesis) 1969 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-18281

The long term storage, isolation, and cooling of light ions in radio-frequency quadrupole traps under ultra-high vacuum conditions is described. The construction and operation of storage ring radio-frequency ion traps is discussed and the application of the bolometric detection technique to stored ions, resulting in measurements of the collisional relaxation times of the ion motion, is included. Dissert. Abstr.

N70-40493# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
MIXING OF HARTREE-FOCK STATES IN Si 28
G. Do Dang Jul. 1970 20 p refs
(LPTHE-70/28) Avail: NTIS

The mixing of the Hartree-Fock states is calculated by requiring that linear combinations of them are eigenstates of the Hamiltonian. It is found that the oblate and spherical J = 0 states are strongly mixed while J not equal to 0 states practically are pure deformed states. The three lowest 0(+) states are assigned to the oblate, spherical, and prolate components. Their transition probabilities to the first 2(+) states are calculated and are found to agree with experimental results, while their relative positions may be accounted for by second-order perturbations. Author

N70-40494 California Univ., San Diego.
A STUDY OF THE REGGE TRAJECTORY OF THE PION USING O(4) GROUP THEORETIC FORMALISM
Hubert Maria Lipinski (Ph.D. Thesis) 1969 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-19700

In the context of the Bethe-Salpeter equation, the properties of the O(4) expansion of the pion proton scattering amplitude are studied. It is found that the expansion has the required kinematical singularities. Assuming the Regge trajectory of the pion has M = 1 at t = 0, the form of the pion pion proton vertex functions for two trajectory mixing models is examined. It is also shown that the expansion satisfies Carlson's theorem. In order to test the M = 1 hypothesis for the pion, the O(4) projected NN Bethe-Salpeter equation for the pion's Regge trajectory in the region near t = 0 is solved. Two Regge trajectories are found with the same quantum numbers as the pion which lie above J = 1. At t = 0, the highest lying trajectory has Toller quantum number M = 1. The other Regge trajectory lies somewhat further below and has the Toller quantum number M = 0. In addition to the intercepts, the slopes of these trajectories are calculated. Dissert. Abstr.

N70-40516# Army Electronics Command, Fort Monmouth, N.J.
DENSITY MATRIX TECHNIQUES Research and Development Report
John P. Tranchina Jun. 1970 67 p refs
(AD-708869; ECOM-3282) Avail: NTIS CSCL 7/4

The objective of this paper is to demonstrate the usefulness of density matrix techniques in the determination of the ground state energy of certain atomic systems. Use of this method, currently under development, results in a lower energy bound in contrast with the Rayleigh-Ritz method which yields an upper bound. The former technique is illustrated for the C++ atomic system. It was found that the Pauli Principle was being violated even when the 2-particle density matrix is expanded in terms of the first fourteen states of Helium. It was shown that significant improvement will probably not be obtained by adding sequentially higher states to the 2-matrix expansion. Very highly excited states must therefore be incorporated into the trial density matrix at the outset if the Pauli restriction is to be satisfied. An attempt is also made to utilize the density matrix techniques on the Triton nuclear system. Author (TAB)

N70-40530# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
DUAL RESONANCE MODELS WITH RESIDUES HAVING A MAXIMUM FIXED FINITE NUMBER OF MONOMIALS IN ONE MANDELSTAM VARIABLE: LOGARITHMIC POLES
E. Cremmer and J. Nuyts Jun. 1970 23 p refs
(LPTHE-70/26) Avail: NTIS

It is shown that in the narrow resonance approximation an amplitude A(s, t) for spinless particle of mass mu which is symmetrical under s, if and only if t crossing can be written as an infinite sum of poles X sub n on the positive real axis in the s channel with residues R sub n(t) which are functions of t only. The resulting amplitude A(s, t) can be expressed in terms of one universal function of two variables F(x, y) however, this leads to rather unsatisfactory physical conclusions. Author

N70-40552*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPECTROSCOPIC ANALYSIS OF ELECTRON-BEAM-INDUCED FLUORESCENCE IN HYPERSONIC HELIUM FLOW
Mervin E. Hillard, Jr., Stewart L. Ocheltree, and Richard W. Storey Washington Oct. 1970 22 p refs
(NASA-TN-D-6005; L-7146) Avail: NTIS CSCL 20H

The ability to visualize low-density hypersonic helium flow was substantially improved through the use of a high-energy (26-keV) electron beam in the Langley 22-inch helium tunnel at a Mach number of about 20. It was found that the electron beam efficiently excites the test gas to produce visible fluorescence throughout the flow field with a brightness which is dependent upon the local gas density. A spectroscopic analysis was made of the electron-beam-induced fluorescence. It was conducted in order to better understand the excitation and emission mechanisms involved and to use this knowledge to improve the visualization technique

further. Spectrograms of the fluorescence, both in the free-stream and model flow fields, were made; and the major radiating species were identified as atomic helium, molecular helium, and the molecular nitrogen ion. The molecular nitrogen ion was found to be the emitter whose fluorescence enhanced the shock structure. Author

N70-40555 Wisconsin Univ., Madison.
PRODUCTION AND REACTIONS OF ALKYL RADICALS FORMED IN ORGANIC GLASSES AT LOW TEMPERATURES BY GAMMA-RADIOLYSIS AND BY PHOTOLYSIS
William George French (Ph.D. Thesis) 1969 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-12366

Through electron spin resonance studies of the kinetics of trapped radical decay, two predominate decay mechanisms were discovered. Radicals produced by gamma-irradiation of a pure hydrocarbon matrix are trapped with an average separation greater than 5 molecular diameters, and decay by random combination with other radicals. The mechanism of radical production in the irradiation of a pure alkane glass is probably an ion-molecule reaction of the type C6H14 + C6H14(+) yields C6H13 + C6H15(+). No hydrogen-deuterium isotope effect is observed on the yield of radicals produced by gamma-irradiation or by dissociative electron capture, nor is an effect observed on the decay kinetics of radicals which combine randomly with other radicals, but deuterated matrices stabilize CH3 and C2H5 radicals, formed by dissociative electron capture, much more effectively than protiated matrices. Dissert. Abstr.

N70-40560*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
Si(n,p) AND Si(n,alpha) REACTION CROSS SECTIONS AT 14.5 MeV NEUTRON ENERGY
Jag J. Singh Washington Oct. 1970 21 p refs
(NASA-TN-D-5946; L-7184) Avail: NTIS CSCL 20H

Measurements of cross sections for (n,p) and (n,alpha) reactions induced by 14.5 MeV neutrons in various isotopes of silicon are described. Author

N70-40568# Tokyo Univ. of Education (Japan). Dept. of Physics.
TWISTING INVARIANT FACTORIZATION IN DUAL RESONANCE MODEL 2 (DUALITY IN THE GENERAL DIAGRAM)
Sunao Sakai [1970] 25 p refs
(TUEP-70-17) Avail: NTIS

Feynman like rules are obtained to construct any planar and non-planar diagrams satisfying duality in the new base vectors which are eigen states of twisting transformation. The general vertex is factorized and it is shown explicitly that the planar and non-planar general Born terms satisfy duality. The gauge property of dual resonance amplitudes, plays an essential role in obtaining these results. Since the general vertex and twisting operator have simple form compared with the conventional one obtained in the P(n) factorization, it will be useful to construct the general planar and non-planar diagrams in the formalism. Author

N70-40605 Pittsburgh Univ., Pa.
THE STUDY OF (d,n) REACTIONS BY RECOIL SPECTROMETRY
Subrahmanya Gangadharan (Ph.D. Thesis) 1969 76 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-15669

The reactions Li-6(d,n)Be-7 (g.s. + 0.431 MeV) and C-12(d,n)N-13 (g.s.) were studied at bombarding energies of 12, 15, and 17 MeV. Experimental absolute differential cross sections are given; the excitation functions are also given over the energy region 12-17 MeV at about 60 deg for both reactions, and for the reaction F-19(d,n)Ne-20 (g.s.). The reactions with Li-6 and C-12 were analyzed by the distorted wave Born approximation. The effects of spin orbit force and finite-range and nonlocality corrections are investigated. The agreement between the experimental and theoretical angular distributions is good for the reactions with Li-6 and the agreement for the reaction with C-12 is quite fair at 17 MeV. The excitation functions for the two reactions are relatively smooth. The experimental abeolute differential cross sections for the reactions with Li-6 agree fairly well with theoretical data obtained by incorporating spectroscopic factors from recent shell model calculations. For the C-12 reaction, the spectroscopic factor from experimental data agrees well with the theoretical value at 17 MeV. The experimental cross sections at 12 and 15 MeV are higher than the theoretical estimates. Dissert. Abstr.

N70-40614 National Lending Library for Science and Technology, Boston Spa (England).
DIFFUSE COLLECTIVE MODES IN THE PARAMAGNETIC PHASE
K. Tomita 8 Jun. 1970 10 p refs Transl. into ENGLISH from Japanese conf. report JAERI-1157 p 80-84
(NLL-LB/9/2740-(9091.9F); JAERI-1157) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Connected with neutron inelastic scattering data, a possibility was suggested to observe diffuse collective modes (or sloppy spin waves) in certain spin systems in the paramagnetic phase. It is known that existing neutron data do not conform to the expectation of a simple theory of the critical slowing down. It is pointed out that in the neighborhood of the critical point, the part of the correlation function which deviates from a linear stochastic theory becomes increasingly important in its contribution to the neutron spectrum. These problems are discussed on the basis of the canonical spin correlation function, evaluated approximately. Author

N70-40631# Ballistic Research Labs., Aberdeen Proving Ground, Md. Nuclear Effects Lab.
A CONCEPT FOR THE MEASUREMENT OF GAMMA-RAY SPECTRA FROM PULSED REACTORS OR FLASH X-RAY MACHINES
Walter R. Van Antwerp Mar. 1970 18 p refs
(AD-708877; BRL-TN-1731) Avail: NTIS CSCL 18/4

The report describes a concept for the measurement of gamma-ray spectra using fixed-energy variable-angle Compton electrons. The choice of a single electron energy eliminates variations in detector response and it can also eliminate the need for variations in detector geometry. Although the dispersion of the proposed spectrograph is very poor at higher gamma-ray energies, this is considered to be an advantage for the low intensities of high-energy gamma-rays produced by flash x-ray machines or pulsed reactors. Author (TAB)

N70-40643# Max-Planck-Institut fuer Kernphysik, Heidelberg (West Germany).
[MAX PLANCK INSTITUTE FOR NUCLEAR PHYSICS] Annual Report, 1969 [MAX-PLANCK-INSTITUT FUER KERNPHYSIK JAHRESBERICHT, 1969]
Herausgeber B. Martin [1969] 192 p refs In GERMAN
Avail: NTIS

Scientific work centered on nuclear reactions induced by heavy ions and the development of corresponding instrumentation and equipment. Participation in the lunar sample analysis program produced: (1) the rare gas distribution in lunar rock samples; (2) the sodium, potassium, cesium, and uranium concentration in lunar dust from the Mare Tranquillitatis; and (3) a mineralogical determination for rocks from the Mare Tranquillitatis. Transl. by G.G.

N70-40649 National Lending Library for Science and Technology, Boston Spa (England).
ANISOTROPIC D(d,n)He-3 REACTION YIELDS IN COPPER SINGLE CRYSTALS
H. Fischer et al 8 Jun. 1970 12 p refs Transl. into ENGLISH from Z. Physik (Berlin), no. 224, 1969 p 135–143
(NLL-LB/9/2863-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A selftarget of deuterium in a single copper crystal is produced by a 75 keV deuteron beam. The neutron yield from the D(d,n)He-3 reaction shows a 30% increase compared with the yield in polycrystalline copper, if the crystal is oriented in <110> to the beam. This result is discussed in terms of the channelling behaviour of the penetrating deuterons parallel to the 110 lattice rows. When positively charged ions are incident in lattice directions or planes of low index in single-crystal targets, the energetic particles tend to move in regions of large impact parameters to the atoms. Atomic nucleus or atomic shell reactions, which require a closer proximity of the energetic particle and the target atom, show a marked reduction (increase) in yield when the reacting atom is located at a lattice site. Author

N70-40698*# Pittsburgh Univ., Pa. Dept. of Physics.
CONFIGURATION SPACE THREE-BODY SCATTERING THEORY
E. Gerjuoy [1969] 115 p refs
(Grant NGR-39-011-035; Contract DA-31-124-ARO(D)440)
(NASA-CR-112362) Avail: NTIS CSCL 20H

The configuration space theory (non-relativistic) three-body scattering is reviewed, with two main objectives: (1) to derive from a very different approach, the general expressions for reaction rates customarily deduced via momentum space procedures; (2) to determine the physical three-particle transition operator, to be distinguished from the conventional transition operator - V VGV, where G is the Green's function. The matrix elements yield a reaction coefficient expressing the probability of true three-body reactions; contained in the matrix elements are terms representing, e.g., purely two-body scattering events. Although the possibility of inelastic processes is fully taken into account, for simplicity the detailed analysis is limited to those transition amplitudes representing elastic scattering under the influence of short range forces; however, the results are relevant to broader classes of reactions and forces. The analysis concentrates on the delta-functions occurring in transition amplitudes, as well as in expressions for a solution to Schroedinger's equation presumably satisfying the boundary conditions at real energy E for specified incident wave. It is found that these delta-functions (in a configuration space formulation) always are associated with (and in effect signal) previous illegitimate mathematical operations. Author

N70-40699*# Pittsburgh Univ., Pa.
CONFIGURATION SPACE THREE-BODY SCATTERING THEORY. Chapters 4 and 5
E. Gerjuoy 1970 146 p
(Grant NGR-39-011-035)
(NASA-CR-112669) Avail: NTIS CSCL 20H
For abstract, see N70-40698.

N70-40700*# Pittsburgh Univ., Pa.
CONFIGURATION SPACE THREE-BODY SCATTERING THEORY, APPENDICES
E. Gerjuoy [1969] 137 p refs
(Grant NGR-39-011-035)
(NASA-CR-112368) Avail: NTIS CSCL 20H
For abstract, see N70-40698.

N70-40760# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
ATOMIC SCATTERING THEORY Final Technical Report
Joseph Callaway 15 Jul. 1970 9 p refs
(Contract N00014-69-A-0211-0001)
(AD-709053) Avail: NTIS CSCL 7/4

Topics discussed briefly in the report include the polarized orbital method, the free-free absorption coefficient of the negative hydrogen ion, photoionization of alkali metal atoms, and positron annihilation in rare gases. Author (TAB)

N70-40819# Princeton Univ., N.J.
THE STRUCTURE OF REGGE POLES AND THEIR RESIDUES AT T EQUALS 0 FOR GENERAL TWO-BODY-TO-TWO-BODY REACTIONS
Jiunn-Ming Wang and Ling-Lie Wang [1970] 73 p refs
Supported by NSF Prepared jointly by Princeton Univ. and Inst. for Advanced Study
Avail: NTIS

A method is introduced to analyze the analyticity requirements from the full helicity amplitudes on the structures of Regge poles and their residues at t = 0 for any two-body-to-two-body reactions of general masses and spins. This method enables visualization of the structure of daughter trajectors and conspirators. This method enables the following derivation for reactions of arbitrary spins. (1) The most singular part of the daughter and conspirator residues at t = 0 are calculated for unequal-unequal-mass reactions and unequal-equal mass reactions reactions. Then through factorization the nonvanishing part of the daughter and conspirator residues are obtained for the equal-equal mass reactions. They are identified with one Lorentz pole expansion. (2) In calculating the daughter and conspirator residues, the analyticity requirements from both the t-channel and the s-channel helicity amplitudes are satisfied. (3) The restrictions on the slope of the daughter trajectories are also obtained. Their independence from external masses and spins are shown. (4) The restrictions on the slope of the conspirators are also calculated. The quantum number M is introduced in the unequal-unequal-mass reactions and then the t factors of the parent as well as the daughter residues are derived. Author

N70-40995# Pennsylvania State Univ., University Park. Spectroscopy Lab.
LIGHT SCATTERING AND MOLECULAR SPECTROSCOPY Final Report, 1 Jul. 1969 – 30 Jun. 1970
D. H. Rank 30 Jun. 1970 10 p refs
(Contract N00014-67-A-0385-0008)
(AD-708441) Avail: NTIS CSCL 7/4

A brief summary of the results obtained during the past year is given. The areas included are molecular spectroscopy, and spontaneous and stimulated scattering. Names of the post-doctoral and pre-doctoral students who have participated are given. Author (TAB)

N70-41016# Northeastern Univ., Boston, Mass. Physics Dept.
RHO, OMEGA PHOTOPRODUCTION PHASE: A POSSIBLE BREAKDOWN IN VECTOR DOMINANCE
Gary Greenhut and Roy Weinstein Sep. 1970 11 p refs
(Grant NSF GP-9217)
(NUB-2027) Avail: Issuing Activity

Using vector meson dominance with real gamma-vector meson coupling constants, the relative rho-omega photoproduction phase in nuclei was calculated as a function of assumed nucleon phases. Recent measurements of this phase are too large to be accommodated by these assumptions. Author

N70-41025# Columbia Univ., Irvington, N.Y. Nevis Labs.
[RESULTS OF RESEARCH BASED ON THE NEVIS SYNCHROCYCLOTRON] Final Report, 1960–1968
May 1970 24 p refs
(Contract Nonr-266(72))
(AD-709159; R-719) Avail: NTIS CSCL 20/8

Results are reported in the following fields: Weak interactions; Electromagnetic interactions and particle structure; Nuclear physics; Atomic, molecular and solid state effects; Techniques and instruments. TAB

N70-41049# Parke Mathematical Labs., Inc., Carlisle, Mass.
CLASSICAL THEORY OF ELECTRON SLOWING DOWN COMPARISON EXPERIMENT Scientific Interim Report
Charles H. Sherman and Nan E. Gordon May 1970 47 p refs
(Contract F19628-68-C-0188)
(AD-709258; AFCRL-70-0324; SR-3) Avail: NTIS CSCL 20/8

Classical differential cross sections for scattering of a free electron by a bound electron are used to calculate the electron slowing down spectrum for cases in which experimental results are available for comparison. The calculations are found to be in good agreement with measurements in aluminum, copper and gold from 300 eV to 20 keV when a single, average, empirically determined binding energy is used. The agreement is not as good when the electronic structure of these metals is included in a more realistic way. Two different approximations to the classical cross section are used, and the one which presumably accounts more completely for the electron binding gives the poorer results. Author (TAB)

N70-41073# Yale Univ., New Haven, Conn.
HIGH ENERGY MOLECULAR BEAMS Final Report, 1 Jul. 1968–30 Sep. 1969
James B. Anderson and John B. Fenn Feb. 1970 12 p refs
(Contract F19628-68-C-0211)
(AD-709407; AFCRL-70-0095) Avail: NTIS CSCL 20/7

A description is presented of research on producing and using high energy and high intensity molecular beams. Two studies were completed. One was concerned with a theoretical and experimental investigation of the Reynolds number dependence of the effective flow diameter of small nozzles used as sources for supersonic molecular beams. The other involved application of seeded-beam techniques to a study of the reaction of hydrogen iodide with deuterium iodide to form HD and iodine. Some implications for future work are discussed. Author (TAB)

N70-41118# Cornell Univ., Ithaca, N.Y. Materials Science Center.
A STUDY OF UMKLAPP SCATTERING AND TRANSPORT COEFFICIENTS IN SIMPLE METALS
Walter E. Lawrence (Ph.D. Thesis) Jan. 1970 121 p refs
(Contract N00014-67-A-0077-0010)
(AD-708411; MSC-1288; TR-11) Avail: NTIS CSCL 20/12

Two-plane-wave models for electron-electron and electron-phonon umklapp scattering, and their effect upon the transport properties of simple metals, are discussed. For the electron-electron scattering problem, a variational approach to the Boltzmann equation is used. According to the model the electron-electron scattering contribution to resistivity is as large in alkali metals as in the simple polyvalent metals that were studied, in apparent contradiction with tentative conclusions drawn from experiment. If further experiments confirm these conclusions, then electron-phonon umklapp scattering is suggested as a possible explanation. It is shown that its contribution to resistivity does not die exponentially at low temperatures in polyvalent metals, as it does in alkali metals. TAB

N70-41138# Aerospace Corp., El Segundo, Calif. Lab. Operations.
TOTAL CROSS SECTIONS FOR THE EXCITATION OF THE TRIPLET STATES IN MOLECULAR NITROGEN, REPORT FOR 1 OCTOBER 1969–1 MARCH 1970
David C. Cartwright 5 Aug. 1970 78 p refs
(Contract F04701-70-C-0059)
(AD-709379; TR-0059(9260-01)-6; SAMSO-TR-70-263) Avail: NTIS CSCL 7/4

A consistent set of total cross sections for electron impact excitation of seven triplet states of molecular nitrogen from the X singlet Sigma(+)(g) state was calculated quantum mechanically for incident electron energies from threshold to 80 eV. The Ochkur-Rudge exchange scattering and Franck-Condon approximations were employed to obtain these cross sections. Minimum and double-minimum basis set LCAO-MO wavefunctions centered on the nuclei were used and the multicenter terms in the scattering amplitude were evaluated using a zeta function expansion. Rotationally averaged cross sections were calculated for excitation from v in. = 0 to individual v ft. - levels of the excited electronic states. The relative magnitudes of these excitation cross sections lead to interesting predictions concerning N2 processes in the upper atmosphere. Author (TAB)

N70-41178# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.
HYPERFINE STRUCTURE OF POSITRONIUM
Thomas Fulton (CERN), David A. Owen, and Wayne W. Repko [1970] 41 p refs Sponsored in part by NSF
Avail: Issuing Activity

The details of a calculation of the m-alpha sup 6 lambda-n-alpha sup minus 1 contributions to the triplet-singlet splitting of the positronium ground state are presented. The result places the theoretical value for the transition frequency approximately one standard deviation above the most recent experimental value. The calculation is performed using a perturbation theory based on the Bethe–Salpeter equation, and on a wave function. After a study of all revelant terms, it is concluded that the only diagrams which contribute to the order are those involving the exchange of one or two virtual transverse photons. These contributions are evaluated, and it is shown that other possible contributions vanish. Author

N70-41228# California Univ., Los Angeles. Dept. of Chemistry.
MULTIPLE RESONANCE TECHNIQUES IN THE STUDY OF MAGNETIC, RADIATIVE AND NONRADIATIVE PROPERTIES OF THE TRIPLET STATE
M. A. El-Sayed Jul. 1970 40 p *Its* Contrib. No. 2657
(Contract N00014-69-A-0200-4012)
(AD-709403; TR-8) Avail: NTIS CSCL 7/4

A physical picture of the origin of the zero field splittings and levels of the three zero field spin states of aromatic molecules is given. At very low temperatures (< 2K), the spin-lattice relaxation processes between these levels can be frozen. Under these conditions, the emission properties of the lowest triplet state are the sum, rather than the population-weighed average, of those of the different emitting zero field levels. Since the rates of pumping and deactivating the different zero field levels of the lowest triplet states are most likely to be unequal, the steady-state population of these three levels becomes unequal, i.e., a state of spin alignment in one molecular direction can be produced. A number of phosphorescence-microwave multiple resonance experiments can thus be carried out from which important information can be determined. Author (TAB)

N70-41246# Alberta Univ., Edmonton. Dept. of Physics.
LATTICE INVESTIGATIONS INTO PHENOMENA OF CRITICAL PHASE TRANSITION TEMPERATURES
Donald D. Betts 7 Jul. 1970 13 p refs
(Grant AF-AFOSR-1310-67)
(AD-709690; AFOSR-70-1869TR) Avail: NTIS CSCL 20/12

The properties of the spin 1/2 Ising model have been

investigated on a regular three dimensional lattice of coordination three and two related lattices. These three lattices are the three dimensional analogues of the honeycomb, triangular and kagome lattices. Hence star-triangle relations have been used to advantage. Both high and low temperature expansions of standard thermodynamic quantities have been obtained. The XY model of a quantum lattice fluid has been studied by the method of high temperature expansion. Several lattice statistical models have been cast in the form of interacting fermion problems. Phase diagrams for Ising models with antiferromagnetic second neighbor interactions have been studied and the exact phase transition interaction ratio at zero temperature has been found for a variety of special cases.
Author (TAB)

N70-41281# Ohio State Univ., Columbus. Van de Graaf Accelerator Lab.
NUCLEAR PHYSICS RESEARCH WITH A 5.5 MeV VAN DE GRAAFF ACCELERATOR Final Progress Report, 1 Oct. 1968 - 30 Apr. 1970
30 Apr. 1970 93 p refs
(Grant NSF GP-10763)
(VDG-006) Avail: NTIS

The nuclear research at the Van de Graaff Laboratory is reported for the period October 1, 1968 to April 30, 1970. The major modifications and additions to the accelerator are discussed. The work in neutron polarization measurements in various reactions, and abstracts of published articles are included.
F.O.S.

N70-41289# California Univ., Irvine.
THEORETICAL STUDIES OF BIMOLECULAR REACTIONS Final Report, 1 Jul. 1967 - 30 Jun. 1970
Don L. Bunker 30 Jun. 1970 3 p
(Contract DAHC04-67-C-0054)
(AD-708906; AROD-7183-3-C) Avail: NTIS CSCL 7/4

Research was conducted in three main areas: Theory of bimolecular processes, Technology of trajectory studies, Molecular beam reactions in which complexes are allegedly formed. The report very briefly discusses the research and findings in these areas.
Author (TAB)

N70-41309*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A PRELIMINARY STUDY OF VIBRATIONAL EFFECTS IN ION-DIPOLE COLLISIONS: CLASSIC TUNNELING
John V. Dugan, Jr. and R. Bruce Canright, Jr. 23 Oct. 1970 14 p refs Presented at the 23d Ann. Gaseous Electron. Conf., Hartford, 21-23 Oct. 1970; sponsored by Am. Phys. Soc. and United Aircraft Res. Lab.
(NASA-TM-X-52893) Avail: NTIS CSCL 20H

Numerical studies of ion-dipole collisions are extended to calculating the effects of vibrational degrees of freedom on capture cross sections and formation of ion-molecule complexes. Two different dipole moment variations about the equilibrium internuclear separation of the oscillator are studied. The capture cross section is sensitive to the oscillator model. Computer-made motion pictures reveal a change in mode of the oscillation due to the ion-dipole interaction. The oscillator becomes constrained so it cannot relax to its equilibrium separation. This shift in oscillator potential barrier is denoted as classical tunneling of the oscillator.
Author

N70-41342*# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemistry.
THE USE OF SINGLE PHOTON COUNTING METHODS IN SOLVING BASIC PROBLEMS IN CHEMILUMINESCENT REACTIONS
John A. Emerson (Ph.D. Thesis) Dec. 1969 77 p refs
(Grant NGL-33-018-007)
(NASA-CR-113932) Avail: NTIS CSCL 20H

A combination of single photon counting and a fast coincidence system found in nuclear physics experiments permits the observation of a dual emission process in a two body luminescent reaction. The lifetime of the excited SO_2 species produced in the SO + O reaction was measured. The process involves the emission of a primary photon from a collisional complex of relatively short lifetime. The experiments conducted consisted of a coincidence analyzer with a flow system. The results were satisfactory, but the lifetime of the excited species was difficult to obtain. The dual emission was therefore observed in several different experimental arrangements.
Author

N70-41362# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
ATOM BEAM RESONANCE STUDIES ON THE HYPERFINE STRUCTURE OF THE EXCITED 4 2P(3/2) STATE IN K-39 BY OBSERVING POPULATION NUMBER CHANGES AT GROUND LEVEL [ATOMSTRAHLRESONANZUNTERSUCHUNG DER HYPERFEINSTRUKTUR DES ANGEREGTEN 4 2P(3/2)-ZUSTANDES VON K-39 DURCH BEOBACHTEN VON BESETZUNGSZAHLAENDERUNGEN IM GRUNDZUSTAND]
Dieter Zimmermann (Ph.D. Thesis) 1968 93 p refs In GERMAN
Avail: NTIS

Occupation of the excited state by circularly polarized radiation directed towards the outer magnetic field and subsequent high frequency changes are used to determine the hyperfine structure constants in the 4 2P3/2 state of K-39. The A factor of the 4 2P3/2 state with its small nuclear pole moment is about three to 10 times smaller than in corresponding states of the Na-, Rb-, or Cs-spectrum. Superimposing curves of neighboring high frequency transfers in the excited state are used to deduce the values for the A and B factors of the 4 2P3/2 state and the electrical quadrupole moment of K-39.
Transl. by G.G.

N70-41376*# Melpar, Inc., Falls Church, Va.
DEVELOPMENT OF THIN TRANSPARENT PHOSPHORS Final Report, 7 Jul. 1965 - 31 Oct. 1969
William R. Lanier 31 Oct. 1969 22 p refs
(Contract NAS5-9224)
(NASA-CR-113971) Avail: NTIS CSCL 18D

Silver-activated zinc sulfide phosphor films having high sensitivity have been produced by a three step process. A layer of zinc sulfide is first deposited by vacuum sublimation. Silver sulfide is deposited on the surface by immersion in a soluble silver salt. This is followed by firing in a non-oxidizing atmosphere containing sodium chloride. These films show good response to low energy protons, and when coupled to a suitable photomultiplier tube, provide a useful means of discriminating protons from other types of radiation.
Author

N70-41379# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
ON STUDIES OF ION-MOLECULAR REACTIONS AT KINETIC ENERGIES ABOVE 0.8 eV [ZUR UNTERSUCHUNG VON ION-MOLEKUEL-REAKTIONEN BEI KINETISCHEN ENERGIEN OBERHALB 0.8 eV]
Adalbert Ding (Ph.D. Thesis) 1968 78 p refs In GERMAN
Avail: NTIS

The effects of impinging ion energy on the reaction Ar(+) with D2 were studied and it was shown that the mean effective ranges at energies below 7 eV and higher were proportional. Calculated absolute mean effectivenesses agreed well with experimental determined values. Two lines in the velocity spectrum of the reaction CD(+) sub 4 plus CD(+) sub 5 yields CD(+) sub 5 plus CD sub 3 were attributed to the stripping process and the complex mechanism. Energy distribution of the produced ion in the reaction CD(+) sub 3 plus CD sub 4 yields C2D(+) sub 5 plus D2 exhibited strong forward scattering in the center of mass system.
Transl. by G.G.

N70-41398# Los Alamos Scientific Lab., N.Mex.
CALCULATION OF ATOMIC ENERGY LEVEL VALUES
Leon J. Radziemski, Jr., Kay J. Fisher, and David W. Steinhaus Jun. 1970 79 p refs
(LA-4402) Avail: NTIS

Two methods for solving the least-squares formulation of the atomic-energy-level calculation problem were coded. The matrix-inversion method is capable of handling a 285-by-1000 level array with up to 19,000 classifications. An important advantage of this method is that the complete variance–covariance matrix is calculated, which leads to the correct computation of calculated wave-number uncertainties. The iterative method is presently capable of accepting a 1000-by-1000 level array with 20,000 transitions. It is inherently capable of computing the least-squares answers to even larger arrays, but has the disadvantage that the variance–covariance matrix cannot be easily calculated. The Gauss–Seidel iterative method as applied to the level calculation problem is demonstrated to be a convergent iterative process. Author (NSA)

N70-41399# Florida Univ., Gainesville. Dept. of Physics and Astronomy.
CHARGED PARTICLE IMPACT PHENOMENA IN SIMPLE SYSTEMS Progress Report and Renewal Proposal
Alex E. S. Green 1 Jun. 1970 102 p refs
(ORO-3798-50) Avail: NTIS

Work under way in programs on aeronomy and energy degradation of electrons is summarized briefly. Proposed research on energy degradation of protons is outlined. A proposed Interdisciplinary Center for Aeronomy and Planetary Atmospheres is described in detail with regard to purpose, administrative structure, existing resources and facilities, budget, and personnel. Copies of two papers prepared for publication and for oral presentation, respectively, are included. Subjects are Analytic Cross Sections for Inelastic Collisions of Protons and Hydrogen Atoms with Atomic and Molecular Gases and Atomic Physics and Aeronomy. NSA

N70-41440# Gulf General Atomic, San Diego, Calif.
ENERGY DEPOSITION STUDIES Annual Summary Report, Period Ending 31 Aug. 1970
D. A. Vroom 22 May 1970 36 p refs
(Contract AT(04-3)-167)
(GA-10133) Avail: NTIS

Progress is reported for the period September 1969 to August 1970 on measurement of secondary electron emission cross sections for several gases subjected to high-energy electron impact. Secondary electron emission cross sections differential in energy and in angle is presented for methane and hydrogen ionized by electrons of 1 to 10 keV. A computer program prepared this year was used to place earlier results for nitrogen on an absolute scale; these results are included. Results for argon are reported in an article being submitted for journal publication; a copy of the article is included as an appendix. NSA

N70-41442# Addis Translations International, Woodside, Calif.
STABILITY OF A BEAM INTERACTING WITH A LOW-Q RESONATOR
Ya. S. Derbenev et al Apr. 1970 12 p refs Transl. into ENGLISH from the Russian Transl. for Stanford Linear Accelerator Center
(SLAC-Trans-115) Avail: NTIS

The coherent transverse stability of a short beam interacting with a low-Q resonator is investigated. It is shown that this interaction may result in so-called memoryless instabilities. Author (NSA)

N70-41443# Los Alamos Scientific Lab., N.Mex.
EVEN-ODD DIFFERENCES AND STRUCTURE OF FISSION BARRIERS
A. V. Ignatiuk et al Dec. 1969 5 p refs Transl. into ENGLISH from the Russian
(LA-TR-69-33; FEI-157) Avail: NTIS

An attempt is made to show the possibility of explaining all data on the even-odd differences of fission barriers within the framework of the concept of double-humped fission barrier. NSA

N70-41446# Purdue Univ., Lafayette, Ind.
DOUBLE REGGE POLE ANALYSIS OF PION(+) PROTON YIELDS PION(+) RHO-MESON(0) PROTON AT 13.1 GeV/c
J. A. Gaidos, C. R. Ezell, J. W. Lamsa, and R. B. Willmann [1970] 33 p refs
(Contract AT(11-1)-1428)
(COO-1428-207) Avail: NTIS

A double-Regge-exchange analysis of the reaction positive pion proton yields positive pion neutral rho meson proton at 13.1 GeV/c is presented. The events are divided into proton diffractive (approximately 80%) and pion diffractive (approximately 20%) categories, each of which requires two double-Regge amplitudes for a complete description. The data of each sample are well described by a double-Regge model consistent with duality. Author (NSA)

N70-41451# Stanford Univ., Calif. High Energy Physics Lab.
PROPERTIES OF NaI(Tl) TOTAL ABSORPTION SPECTROMETER FOR ELECTRONS AND GAMMA RAYS AT GeV ENERGIES
E. B. Hughes, R. L. Ford, R. Hofstadter, L. H. O'Neill, and J. N. Otis Mar. 1970 14 p refs Presented at 12th Scintillation and Semiconductor Counter Symp., Washington, D.C., 11-13 Mar. 1970
(Contract Nonr-225(67); Grant NSF GP-9498)
(AD-709422; HEPL-626) Avail: NTIS CSCL 18/4

In the past two years the authors have reported on the properties of large NaI(Tl) crystals as total absorption spectrometers for electrons and gamma-rays in the range 0.1 to 14 GeV. They have recently made similar measurements on a NaI(Tl) spectrometer which is both larger than any that they have used before, and assembled in a different way. The report describes the results of the initial tests. Author (TAB)

N70-41462# Brown Univ., Providence, R.I. Dept. of Physics.
RESEARCH PROGRAM IN THEORETICAL HIGH ENERGY PHYSICS Progress Report, 1 Sep. 1969 – 31 Aug. 1970
David Feldman 1 Jun. 1970 9 p refs
(Contract AT(30-1)-2262)
(NYO-2262-TA-220) Avail: NTIS

A summary of research on theoretical high-energy physics at Brown University for the year from September 1, 1969 to August 31, 1970 is presented. Theoretical papers published during the past year and papers in press are listed. NSA

N70-41473# Stanford Linear Accelerator Center, Calif.
IMPORTANT PROBLEMS AND QUESTIONS FOR THE NEW ACCELERATORS
S. D. Drell May 1970 34 p refs Presented at Intern. Conf. on Expectations for Particle Reactions at the New Accelerators, Madison, Wis., 30 Mar.–1 Apr. 1970 Sponsored by AEC
(SLAC-PUB-745; CONF-700314-2) Avail: NTIS

A speculative discussion is given on particle interactions and properties to be discovered using very high energy accelerators. This discussion covers asymptotic projections, inelastic processes including deep inelastic scattering, the proton constituents of hadrons, and elastic scattering. NSA

N70-41474# California Univ., Berkeley. Lawrence Radiation Lab.
THE MESON SPECTRUM IN THE REACTION pp YIELDS d MM
Arthur Barry Wicklund (Ph.D. Thesis) Mar. 1970 183 p refs
(Contract W-7405-eng-48)

(UCRL-19737) Avail: NTIS

A spark-chamber spectrometer is used to study the meson spectrum in the reaction p + p yields d + MM at 3.8 to 6.3 GeV/c. Evidence is found for the production of an isospin-1 resonance in the p + p yields d + delta(+) reaction. This resonance has a mass of 975 MeV and a width of 60 MeV. NSA

N70-41487# Stanford Univ., Calif. High Energy Physics Lab.

M5 AND HIGHER MAGNETIC MOMENTS IN ELASTIC ELECTRON SCATTERING

G. C. Li, I. Sick, J. D. Welecke, and G. E. Walker 1970 14 p refs Submitted for publication Sponsored in part by NSF

(Contract F44620-68-C-0075)

(AD-709241; HEPL-629; ITP-362) Avail: NTIS CSCL 20/8

Consideration is given to the feasibility of determining the higher nuclear ground state magnetic moments through elastic electron scattering. Theoretical and experimental results are presented for the M5 moment of 27Al and the M9 moment of 209Bi. Author (TAB)

N70-41497# Oak Ridge National Lab., Tenn.

KERMA FACTORS AND SECONDARY GAMMA-RAY SOURCES FOR SOME ELEMENTS OF INTEREST IN THERMONUCLEAR BLANKET ASSEMBLIES

J. J. Ritts, M. Solomito, and D. Steiner 12 Jun. 1970 53 p refs

(Contract W-7405-eng-26)

(ORNL-TM-2564) Avail: NTIS

Neutron and gamma-ray fluence to kerma factors were calculated for lithium-6, lithium-7, beryllium, carbon, fluorine, copper, and niobium. Secondary gamma-ray spectra were calculated for lithium-6, lithium-7, carbon, fluorine, and niobium. An attempt was made to include all significant reactons, i.e., elastic scattering with an anisotropic correction, inelastic scattering, neutron capture, (n,2n) reactions, (n,charged particle) reactions, and beta or positron emissions from these reactions. The kema factors and secondary gamma-ray spectra presented herein have proved extremely useful in the calculation of heating rates within thermonuclear blanket assemblies. Author (NSA)

N70-41499# Atomic Energy Commission, New York. Health and Safety Lab.

BROAD BEAM Cs 137 and Co 60 GAMMA TRANSMISSION THROUGH LAMINATED LEAD-CONCRETE BARRIERS

Harold L. Beck Jun. 1970 20 p refs

(HASL-231) Avail: NTIS

The transmission of normally incident broad beams of Cs-137 and Co-60 gamma rays through various thicknesses of lead barriers followed by concrete barriers is calculated, using a half-range Legandre polynomial approximation to the Boltzman transport equation. The method reproduces well the available experimental results for simple barriers. The calculated laminated barrier transmission factors conveniently lead to more realistic shielding requirements for radiography and teletherapy facilities than combinations of transmission factors for simple barriers. The uncertainties in the calculated results are estimated to be less than + or – 5%. The reverse calculation, for a concrete barrier followed by a lead barrier, indicates that lining the outer surface of the concrete with a thin layer of lead increases the efficiency of the shield. The results also show how exposure rates vary in-between the lead and concrete barriers, and how the gamma-ray spectrum is modified in penetrating various shield combinations. Author (NSA)

N70-41500# Gulf General Atomic, San Diego, Calif.

GAPER-2D: A TWO DIMENSIONAL TRANSPORT PERTURBATION THEORY PROGRAM

R. J. Archibald and D. A. Sargis 29 Apr. 1970 61 p refs

(Contract AT(04-3)-167)

(GA-10103) Avail: NTIS

A two-dimensional first order transport perturbation theory program, GAPER-2D, was written to evaluate reactivity coefficients in reactor assemblies. Scalar neutron fluxes and currents, as computed by a two-dimensional discrete ordinates code in r-z or x-y geometry, are utilized with leakage and anisotropic scattering effects treated in a P (sub 1) approximation. The program computes contributions to the change in inverse multiplication factor delta (1/k) due to perturbations in the individual capture, net fission, total scattering, (n,2n), inelastic scattering, and leakage cross sections. The individual contributions are computed and displayed for each energy group and for each perturbed region within the assembly. Numerical calculations have been in good agreement with direct transport results and the perturbation theory calculations require far less computer execution time than the corresponding discrete ordinates computations. Author (NSA)

N70-41501 National Lending Library for Science and Technology, Boston Spa (England).

CHANNELS OF THE REACTION PION(–) p YIELDS n PION(+) PION (–) m PION (0) AT pc EQUALS 4 GeV

V. G. Grishin et al 8 Jun. 1970 20 p refs Transl. into ENGLISH of Russian report JINR-R1-4412

(NLL-LB/9/2890-(9091.9F); JINR-R1-4412) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Pion-proton reactions were studied using stereofilms from a 24 liter propane bubble chamber. The reactions were recorded from pair production. The events were measured, computed, and stored on magnetic tape. Ionization and missing mass were calculated for each event. Reactions involving strange particles are also discussed. E.H.W.

N70-41504# Oak Ridge National Lab., Tenn.

MECHANISMS AND APPLICATIONS OF NUCLEAR TRACK REGISTRATION IN POLYMERS

D. R. Johnson and Klaus Becker Jun. 1970 47 p refs

(Contract W-7405-eng-26)

(ORNL-TM-2826) Avail: NTIS

The radiolytic damage mechanism for latent nuclear track formation in polymers has been corroborated using a stable free radical, DPPH, as a radical scavenging additive to sensitive cellulose nitrate and cellulose acetate foils. The G-value for free radical production has been measured as a function of linear energy transfer, and environmental effects on the track registration efficiency have been studied. For the automatic counting of etched alpha particle tracks and the imaging of their spatial distribution, a technique based on the local evaporation of a thin metal layer with electrical discharges occurring through perforations in cellulose nitrate foils has been developed. This method has been used for the evaluation of a newly developed radon progeny personnel dosimeter for uranium miners; for the ultrasensitive determination of quantity and distribution of fissile materials in biological and other samples by neutron-induced autoradiography; and for increasing the sensitivity in quantitative alpha-autoradiography. Author (NSA)

N70-41506# Atomic Energy Commission, New York. Health and Safety Lab.

NUCLEAR EMULSION SPECTROMETRY AT LOW AND INTERMEDIATE NEUTRON ENERGIES

Robert S. Sanna, James E. McLaughlin, and Keran O'Brien Jun. 1970 53 p refs Revised

(HASL-230) Avail: NTIS

Improvements and changes in techniques for using nuclear track emulsions as neutron spectrometers are described. Emulsion development procedures, necessary data corrections, control of scanning errors, error propagation, and the analyses used to infer the neutron spectra are summarized. To test the spectrometer system, pseudo-proton track data were generated from a Pu238Be

spectrum by a Monte Carlo technique and used to produce a neutron spectrum for comparison with the original spectrum. Spectra from real measurements are presented. Author (NSA)

N70-41508# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Engenieurwissenschaften.
APPLICATION OF LEVEL CROSSING TECHNIQUE FOR STARK EFFECT STUDIES ON THE HYPERFINE STRUCTURES OF EXCITED INDIUM NUCLEAR SPIN LEVELS [STARK-EFFEKT-UNTERSUCHUNGEN IN DER HYPERFEINSTRUKTUR ANGEREGTER IN I-TERME UNTER VERWENDUNG DER LEVEL-CROSSING TECHNIK]
Peter Zimmermann (Ph.D. Thesis) 1968 41 p refs In GERMAN
Avail: NTIS

Level crossing analyses of the excited 5s(2)5d 2D sub 3/2 and 5s(2)5d 2D sub 3/2 states in the hyperfine indium spectra established the magnetic nuclear dipole constants A and electrical nuclear quadrupole constants B for both levels; additional level crossings, caused by application of a third electrical field, determined Stark constants in both levels and the plus or minus properties of the hyperfine structure constants A and B relative to the Stark constants. The measured negative B/A relationships of both terms at known positive magnetic nuclear dipole moments and electric nuclear quadrupole moments for In-115 are explained by possible interference-disturbance configurations. Transl. by G.G.

N70-41512# Stanford Linear Accelerator Center, Calif.
ELECTROMAGNETIC INTERACTIONS AT VERY HIGH ENERGY
J. D. Bjorken May 1970 21 p refs Presented at Intern. Conf. on Expectations for Particle Reactions at the New Accelerators, Madison, Wisc., 30 Mar.–1 Apr. 1970 Supported by AEC
(SLAC-PUB-736; CONF-700314-1) Avail: NTIS

Scaling laws which suggest how to extrapolate to higher energies for hadron interactions are discussed. These scaling laws have some basis from experimental data. This includes two-body and quasi-two-body photoproduction and deep inelastic electroproduction. Also scaling behavior based more on theoretical conjecture than on experimental data is considered. These scaling laws include the productions for single-particle spectra according to Feynman and Yang, and conjectures for hadron yields in colliding-beam experiments. Other miscellaneous electromagnetic topics are also considered. NSA

N70-41513# Gulf General Atomic, San Diego, Calif.
ENERGY DEPOSITION STUDIES Three Year Summary Report, Period Ending 31 Aug. 1970
D. A. Vroom 22 May 1970 104 p refs
(Contract AT(04-3)-167)
(GA-10135) Avail: NTIS

The main research accomplishments and apparatus built during a three-year study of energy deposition by fast particles in gases are summarized. Some data on angular distributions of secondary electrons from impact of 1- to 10-keV electrons of argon, methane, nitrogen, and hydrogen are included. Results of photoionization studies have been published; reprints of three papers giving these results are included in an appendix. Plans for continuation of the program are outlined. NSA

N70-41546# Atomic Energy Commission, Washington, D.C. Div. of Isotopes Development.
RESEARCH AND DEVELOPMENT PROJECTS Progress Reports on Sponsored Work
Feb 1970 166 p refs
(TID-25372) Avail: NTIS

A 1969 summary of the objectives, progress, results, and future plans for each of the research and development projects of the AEC Division of Isotopes is presented. The projects are separated into the following categories: radioisotopes production and materials; thermal applications development; uses in environmental and ocean sciences; radiation analysis and control process radiation; radiation preservation of foods; and information services related to radioisotopes uses. NSA

N70-41554# Stanford Linear Accelerator Center, Calif.
BROKEN SCALE INVARIANCE AND ANOMALOUS DIMENSIONS
Kenneth G. Wilson May 1970 21 p refs Presented at the Midwest Conf. on Theoret. Phys., Notre Dame, Ind., 3–4 Apr. 1970 Sponsored by AEC
(SLAC-PUB-737) Avail: NTIS

Mack and Kastrup have proposed that broken scale invariance is a symmetry of strong interactions. There is evidence from the Thirring model and perturbation theory that the dimensions of fields defined by scale transformations will be changed by the interaction from their canonical values. These ideas and their consequences for strong interactions are reviewed. Author (NSA)

N70-41585# Boston Coll., Chestnut Hill, Mass. Dept. of Chemistry.
VIBRATIONAL EXCITATION IN A MORSE OSCILLATOR. FRANCK-CONDON FACTORS FOR THE TRANSITIONS N2, C TRIPLET pi u TO B TRIPLET pi g AND CN, B DOUBLET SIGMA(+) TO X DOUBLET SIGMA(+)
Jeong-Long Lin, Bajoy Chakraborty, and Yuh-Kang Pan Jul. 1970 38 p refs
(Contract N00014-69-A-0453)
(AD-709465; FRK-107) Avail: NTIS CSCL 7/4

Vibrational excitation in the system He + H2 is studied theoretically by considering H2 as a rotating Morse Oscillator. The anharmonicity of molecular vibration is found to have only a small effect on the 0 to 1 transitions. Vibrational transition probabilities are also found to be insensitive to the rotational energy of the diatom. Following the approach of Mies and Shuler, based on the modified wave number approximation, three-dimensional transition probabilities are calculated from one-dimensional results and the steric factor obtained as a function of the collision energy. Franck-Condon factors for the transitions N2, C triplet Pi(u) to B triplet Pi(g) and CN, B doublet Sigma(+) to X doublet Sigma(+) have been calculated by the method of Chang and Karplus. Author (TAB)

N70-41573# Institute for Advanced Study, Princeton, N.J. Syracuse Univ., N.Y.
ELECTROMAGNETIC FORM FACTORS OF THE NUCLEON AND THE PION
Jacob G. Kuriyan and E. C. G. Sudarshan [1970] 9 p refs Sponsored in part by NSF Prepared in cooperation with Syracuse Univ.
Avail: NTIS

The assignment of Dirac spin 1/2 or UIR of O(3,1) is studied for particles involving a covariant infinite-component field equation. Canonical forms are used to describe interactions in terms of noninvariant generators, and a larger group structure (dynamical noninvariance group) is postulated. It is assumed that the current that is coupled to the neutral vector meson which interacts with the baryon and mesons causes transitions between the various levels. The theory of primary interactions is used to find the initial and final moments, and the direct computation of the electric and magnetic form factors for the proton is presented. F.O.S.

N70-41590# IIT Research Inst., Chicago, Ill. Technology Center.
SCAVENGING STUDY OF SNOW AND ICE CRYSTALS Quarterly Progress Report, 1 Feb.–30 Apr. 1970
Sudesh K. Sood and Meryl R. Jackson 11 May 1970 23 p refs
(Contract AT(11-1)-578)
(IITRI-C-6105-11) Avail: NTIS

Scavenging efficiency of naturally precipitating snow and ice crystals for 0.234 microns polystyrene latex and sodium chloride particles in the size range 0.1 to 0.16 microns was studied during this report period. Expreimental results showed that scavenging efficiency was a function of both the snow crystal and particle size. Some experimental work was also done to determine the scavenging efficiency of sulfur dioxide by snow. Author (NSA)

N70-41598# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.

STUDIES OF SCILARD-CHALMERS REACTIONS ON COMPOUNDS WITH LAYERED STRUCTURES FOR PRODUCING ENRICHED RADIO NUCLIDES [UNTERSUCHUNGEN VON SZILARD-CHALMERS-REAKTIONEN AN VERBINDUNGEN MIT SCHICHTSTRUKTUR ZUR GEWINNUNG ANGEREICHERTER RADIONUKLIDE]

Helmut Winkler (Ph.D. Thesis) 1968 103 p refs In GERMAN
Avail: NTIS

Activation yields and enrichment factors of Na, Ba, Co, Mn, and Zn in layered silicates were studied in relation to fixation temperatures; effects of recovery conditions and radiation dosage on the enrichment factor of manganese ions were also observed. It was found that activity yields decreased with increasing fixation temperatures to 50-60% at 200 C. Enrichment factors depended also on fixation temperatures but were definitely determined by the elution media used in the exchange of non-movable ions of the intermediate neutron activation layer. Barium backscatter from an intermediate layer into a silicon layer yielded an enrichment factor of about 100 and an activity fixation yield of between 10 and 30%. Transl. by G.G.

N70-41617# Arcon Corp., Wakefield, Mass.

BEAM FOIL EXCITATION STUDIES Final Report, 15 Dec. 1969 - 10 Jun. 1970

Dennis S. Barton 10 Jun. 1970 34 p refs
(Contract F19628-70-C-0143)
(AD-709713; R-70-2W; AFCRL-70-0363) Avail: NTIS CSCL 7/4

Studies dealing with the effects of collisional excitation of ion beams by thin foils have been carried out for the purpose of providing a theoretical and analytical basis for an existing AFCRL experimental beam foil spectroscopy program. Primary emphasis has been placed upon the development of semi-empirical models applicable to the prediction of equilibrium charge-state distributions in collisionally excited ion beams. In general, such distributions are well described by Gaussian shapes in the case of relatively light ions ($Z < 10$), significant deviations occurring with increasing ion atomic number and decreasing beam velocity. Author (TAB)

N70-41621# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.

THE FLUORESCENCE OF MOLECULES IN LIQUID SOLUTIONS SUBJECTED TO HIGH EXCITATION INTENSITIES [ZUR FLUORESZENZ VON MOLEKUELEN IN FLUESSIGER LOESUNG UNTER DEM ENFLUSSHOHER ERREGUNGSINTENSITAETEN]

Werner Rapp (Ph.D. Thesis) 1968 113 p refs In GERMAN
Avail: NTIS

A set of integrodifferential equations for the transient response of photon and electron density in an excited state is derived. Since the differential equation governing the photon density displays a strongly heuristic tendency, a physically plausible integral equation is derived and compared with the Statz-de Mars equations. Based on the study of the set of modified Statz-de Mars equations for describing the electromagnetic field and the equations of motion for the density matrix, it is shown that the related integrodifferential equations are valid only when the final level of the absorption process and the final level of fluorescence are discharged in a single time interval, during which the photon and electron density undergo no apparent changes; there is weak absorption; small time intervals after the light source has been switched on are not considered; and the fluorescent light displays a sufficiently incoherent portion. Transl. by R.B.

N70-41634# Los Alamos Scientific Lab. N.Mex.

DEVELOPMENT AND TESTING OF LEMP 1

H. J. Longley and C. L. Longmire (Los Alamos Nucl. Corp.) 14 Apr. 1970 28 p
(Contract W-7405-eng-36)
(LA-4346) Avail: NTIS

LEMP 1 is a computer code for obtaining the solution, by finite difference methods, of Maxwell's equations in two space dimensions and retarded time, for the electromagnetic fields produced by a nuclear burst on the ground. The field components are considered in the usual spherical coordinates. These fields are calculated in the air, in the ground, and on the ground-air interface. In the ground the electrical conductivity is constant in time and space, and the source current is zero. The conductivity in the air is found by solving the air-ion equations, which take account of gamma-induced ionization, electron attachment to O2, and electron-ion and ion-ion recombination. The source current in the air is the Compton recoil current produced by gamma rays, the source and transport of which are given by a fairly general and flexible prescription. The back-action of the fields on the air conductivity and the source current is treated. Author (NSA)

N70-41637# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.

PHOTO NUCLEAR REACTIONS

N. C. Francis [1969] 6 p
(Contract W-31-109-eng-52)
(KAPL-P-3866) Avail: NTIS

The use of the photon as a probe for the study of nuclear reaction and structure theory is considered. The meson photoproduction cross section of complex nuclei, giant dipole resonances, (gamma,neutron) reactions, and neutron capture are briefly discussed. NSA

N70-41638# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.

NEUTRON CROSS SECTION

C. A. Conrad 13 Nov. 1969 9 p
(KAPL-P-3844) Avail: NTIS

The neutron cross section and its experimental determination are discussed. The standard method of analysis used at most laboratories for low and intermediate energy resonance are presented. NSA

N70-41639# Oak Ridge National Lab., Tenn. Office of Language Services.

RADIATION SHIELDING OF A CYLINDRICAL SELF-ABSORBING SOURCE IN THE AXIAL DIRECTION

F. W. Krueger et al Jun. 1970 6 p refs Transl. into ENGLISH from Kernenergie (East Ger.), v. 12, 1969 p 390-394
(ORNL-tr-2319) Avail: NTIS

The tables of an integral function given in a previous paper for the calculation of radiation flux from a cylindrical self-absorbing source behind a shield in axial directiion are extended. Author (NSA)

N70-41656# Princeton Univ., N.J. Dept. of Chemical Engineering.

[ON RADIATION CHEMISTRY] Summary of Progress, 15 May 1969 - 15 May 1970

15 Jun. 1970 13 p refs
(Contract AT(30-1)-2807)
(NYO-2807-62) Avail: NTIS

Topics covered include: energy transfer in gases, energy deposition by fission fragments for chemonuclear applications,

Mossbauer studies of phase transitions, Mossbauer studies of lattice dynamics, Mossbauer studies of bonding in ferrous compounds, radiation chemistry of N2 and of H2 - D2, semiconductor particle detector studies of fission fragment energy loss, radiation chemistry and damage induced by fast neutrons, Mossbauer studies of krypton compounds, anomalous charge states in Mossbauer spectra, lattice and molecular dynamics from Mossbauer data, anharmonicity and phase transitions, Mossbauer instrumentation, and quantitative analysis in corrosion studies by Mossbauer effect. NSA

N70-41669# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.

PHOTO NUCLEAR REACTIONS AND INTERMEDIATE STRUCTURE

N. C. Francis [1970] 7 p

(Contract W-31-109-eng-52)

(KAPL-P-3867) Avail: NTIS

The use of the photon for the study of nuclear reaction and intermediate structure theory is considered. Giant dipole resonance, (gamma,n) reactions, and neutron capture are discussed. NSA

N70-41685# Addis Translations International, Woodside, Calif.

DAMPING THE COHERENT OSCILLATIONS OF A BEAM IN A STORAGE RING [O DEMPFIROVANII KOGERENTNYKH KOLEBANII PUCHKA V NAKOPITELE]

Ya. S. Derbenev et al Apr. 1970 19 p refs Transl. into ENGLISH from Russian Preprint No. 318 23 p Prepared for Stanford Linear Accelerator Center, Calif.

(SLAC-Trans-114) Avail: NTIS

The stability of the coherent phase motion of a beam interacting, along a segment of the chamber, with an ideally matched line, is investigated. It is shown that under certain conditions this interaction may result in so-called memory-less instabilities of the synchrotron and radial betatron motion. The damping conditions and expressions for the decrements of synchrotron excitations of arbitrary multipolarity are also derived. Author (NSA)

N70-41691# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Chemistry.

ELECTRONIC STRUCTURE OF MOLECULES BY VARIATIONAL METHODS AND CORRELATION CORRECTIONS Final Scientific Report, 1 Nov. 1965 - 31 Oct. 1969

Donald R. Whitman and K. Douglas Carlson 1970 12 p refs

(Grants AF-AFOSR-1030-66; AF-AFOSR-1438-68)

(AD-709706; AFOSR-70-2010TR) Avail: NTIS CSCL 7/4

The report summarizes research concerned with theoretical studies of the electronic structures and properties of atoms and molecules carrier out by ab initio methods based on the Roothaan matrix Hartree-Fock approximation. These studies include: (1) analyses of certain mathematical procedures and the production of efficient expansion basis functions for atoms and molecules; (2) studies of correlation energy contributions in atoms of the transition metals; (3) investigations of the electronic structures of transition-metal diatomic molecules; and (4) studies of the conformation of several important small polyatomic molecules. Author (TAB)

N70-41695# Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.

ESR-INVESTIGATIONS DURING THE RADIOLYSIS OF AQUEOUS SOLUTIONS

Klaus Eiben and Richard W. Fessenden 5 Jun. 1970 3 p Presented at the 4th Intern. Congr. of Radiation Res., Evian, France 29 Jun. - 4 Jul. 1970 Prepared in cooperation with Kernforschungszentrum, Karlsruhe

(Contract AT(30-1)-2310)

(RRL-2310-304; CONF-700610-1) Avail: NTIS

A new in situ ESR technique was developed, which allows the direct detection of transient radicals during the radiolysis of aqueous solutions. An electron beam of a 2.8-MeV Van de Graaff was focused on the solution in the quartz cell, generating the transient radicals that were recorded with a Varian ESR spectrometer. For reactions of the hydrated electrons with several dissolved organic compounds it was revealed that radical intermediates are produced by either electron addition or dissociative electron attachment. Author (NSA)

N70-41725# Addis Translations International, Woodside, Calif.

COLLIDING-BEAM EFFECT. PART 1: PERTURBATION UNDERGONE BY A PARTICLE CROSSING A BUNCH

J. E. Augustin [1970] 16 p refs Transl. into ENGLISH from French Report 36-69-JEA-LN Sponsored by AEC Prepared for Stanford Linear Accelerator Center

(SLAC-Trans-116; Rept-36-69-JEA-L-Pt-1) Avail: NTIS

In an electron - positron storage ring the motion of a particle crossing a bunch of the opposed beam is modified by the electromagnetic force due to the charge of the bunch. The bunches of particles have a trigaussian density, and this property is used to calculate exactly the angular perturbation undergone by the particle, which is obtained in particular in the form of a series expansion having as parameters the amplitudes of the particle's betatron oscillations. The result will be applied to various effects pertaining to the space-charge compensation in a four-beam machine (Coppelia project), as well as the resultant distribution of wave numbers in the beams. Angular perturbation in a head-on collision and crossing at an angle are considered. Author (NSA)

N70-41728# Princeton Univ., N.J. Dept. of Chemistry.

NEW NEUTRON RICH ISOTOPES PRODUCED IN 3GeV PROTON REACTIONS

G. M. Raisbeck, P. Boerstling, P. W. Riesenfeldt, R. Klapisch, T. D. Thomas et al Sep. 1969 8 p refs Supported in part by AEC Prepared jointly by Princeton-Pa. Accelerator and Princeton Univ.

(PUC-937-369) Avail: NTIS

The study of neutron rich, light isotopes (7 < or = A < or = 25) produced at relatively low kinetic energy from the reaction of 3 GeV protons on Au-197 is discussed. The immediate object of these experiments is to establish the limits of particle stability for neutron rich isotopes with Z < or = to 8. The limit of heavy particle stability represents a sensitive test for the various procedures used for predicting nuclear masses far removed from the valley of beta stability. NSA

N70-41736# Aerospace Corp., El Segundo, Calif. Lab. Operations.

CROSS SECTIONS FOR POSITIVE-ION AND ELECTRON PRODUCTION IN COLLISIONS OF 1-25 KeV HYDROGEN ATOMS WITH ATOMIC AND MOLECULAR GASES Report for 1 Jul. 1969 - 15 Mar. 1970

Robert J. McNeal, David C. Clark, and Robert A. Klingberg 15 Jun. 1970 38 p refs

(Contract F04701-69-C-0066)

(AD-709198; TR-0066(9260-01)-8; SAMSO-TR-70-231) Avail: NTIS CSCL 7/4

Cross sections are reported for production of positive ions and electrons in collisions of hydrogen atoms in the energy range 1-25 keV with He, Ne, A, Kr, Xe, H2, and O2. Slow, positive ions are produced by capture of an electron by the fast atom from the target gas and by ionization of the target. Electrons are produced by target gas ionization and by stripping of the fast atom. Ionization cross sections for each of the target gases are derived from the positive ion production cross sections and previous measurements of the capture cross sections. Author (TAB)

N70-41758# Rensselaer Polytechnic Inst., Troy, N.Y.
NEUTRON EVAPORATION IN HEAVY ION INDUCED REACTIONS
Daniel Sperber Jul. 1969 5 p refs
(Contract AT(30-1)-3947)
(TID-25391) Avail: NTIS

A method for calculating the excitation function for the evaporation of a specified number of neutrons in heavy ion induced reactions in which fission competes with neutron evaporation is discussed. Reactions are treated in which the radiation width can be neglected in comparison with the neutron or fission width. NSA

N70-41766# Addis Translations International, Woodside, Calif.
COLLIDING-BEAM EFFECT. PART 2: WAVE-NUMBER DRIFT; CASE OF TWO BEAMS; APPLICATION TO TRANSVERSE INSTABILITY CREATED BY SECOND BEAM; APPLICATION TO SPACE-CHARGE COMPENSATION WITH FOUR BEAMS
J. E. Augustin [1970] 27 p refs Transl. into ENGLISH from French Report 8-70-JEA-LN Sponsored by AEC Prepared in cooperation with Stanford Linear Accelerator Center.
(SLAC-Trans-117; Rept-8-70-JEA-LN) Avail: NTIS

After calculating the general formula giving the wave-number drift for a particle, the head-on collision between two beams circulating in the same orbit is studied. In this case it is possible to calculate completely the distribution of the wave numbers in the beams. The result is used to explain an observation made with the Orsay storage ring, namely that the presence of a second beam of low intensity may produce a transverse instability in the already stored beam. This is interpreted as a modification of the Landau damping in that beam due to a change in the distribution of its wave numbers caused by the weak beam. Author (NSA)

N70-41784# Gulf General Atomic, San Diego, Calif.
FAST REACTOR SPECTRUM MEASUREMENTS Quarterly Progress Report, Period Ending 30 Apr. 1970
J. C. Young, P. d'Oultremont, J. M. Neill, G. M. Borgonovi, and D. H. Houston 15 May 1970 22 p refs
(Contract AT(04-3)-167)
(GA-10146) Avail: NTIS

Preparation of a topical report to document the data reduction codes used in reducing the raw time-of-flight data was concluded. The STSF-1A time-of flight data were reanalyzed, and the first core (STSF-7) was designed and all approvals obtained for loading. Further studies included proton recoil measurements, and initiate time and energy measurements utilizing a He-3 detector. Author

N70-41787+ California Univ., Berkeley. Lawrence Radiation Lab.
WEAK INTERACTIONS: ON THE EXISTENCE OF NEUTRAL LEPTONIC CURRENTS
Rolland P. Johnson (Ph.D. Thesis) 2 Apr. 1970 69 p refs
(Contract W-7405-eng-48)
(UCRL-19709) Avail: NTIS

New upper limits to the branching ratios for kaon(0) sub L were set: kaon(0) yields muon(+) muon(−), kaon(0) yields positron electron, and kaon(0) yields muon(+ or −) electron or positron. A two-armed spectrometer system for the simultaneous detection of these decay modes and the normalizing kaon(0) yields pion(+) pion(−) mode is described. No events of the muon muon, electron electron or muon electron type were observed. Twenty-three thousand kaon(0) yields pion(+) pion(−) events with detection efficiency corrections then determine new branching ratio upper limits relative to all kaon(0) modes of 1.1 × 10 to the minus 7th power for all three leptonic modes. Author (NSA)

N70-41794*# Pittsburgh Univ., Pa. Physics Dept.
CALIBRATION OF VACUUM ULTRAVIOLET MONOCHROMATORS BY THE MOLECULAR BRANCHING-RATIO TECHNIQUE
M. J. Mumma and E. C. Zipf Jul. 1970 24 p refs
(Grant NGL-39-011-030)
(NASA-CR-113860; SRCC-137) Avail: NTIS CSCL 20H

The Lyman-Birge-Hopfield system and the CO fourth positive system are readily excited by low energy electrons (100 eV). Together these molecular systems have numerous emission bands spread uniformly over the wavelength region 1150 A to 2500 A. Because the absolute transition probabilities for both of these systems have been accurately measured, relative measurements of the intensity of these bands excited by electron impact can be used as a convenient technique for calibrating VUV monochromators. This is the basis of the molecular branching ratio technique described. These relative measurements can be placed on an absolute basis by comparing the band intensities to the brightness of the hydrogen Ly alpha line (1215 A) and the OI resonance triplet (1302, 4, 6 A) produced by the dissociative excitation of H2 and O2 respectively and to a standard lamp at wavelengths greater than 1500 A. The results obtained by this method are shown to be in excellent agreement with spectral response measurements obtained using the atomic branching ratio technique. Author

N70-41795# Rochester Univ., N.Y.
FUNDAMENTAL STUDIES IN ISOTOPE CHEMISTRY Progress Report, 1 Jul. 1969 – 30 Jun. 1970
Jacob Bigeleisen 30 Jun. 1970 36 p refs
(Contract AT(30-1)-3999)
(UR-3999-9) Avail: NTIS

Topics covered include: molal volumes of the isotopic homologues of ethylene, vapor pressures of Ar-36 and Ar-40, and correlations of isotope effects with molecular forces. NSA

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N70-40417# Aerospace Corp., El Segundo, Calif. Lab. Operations
SHOCK TUBE STUDIES OF SULFUR TETRAFLUORIDE DISSOCIATION, SEPTEMBER – NOVEMBER 1969
Jerry F. Bott 15 Mar. 1970 28 p refs
(Contract F04701-69-C-0066)
(AD-708470; SAMSO-TR-70-205) Avail: NTIS CSCL 20/9

Shock tube studies of SF4 dissociation were made in the temperature range from 1650 to 1950K. Rate constants for the initial fragmentation of SF4 have been determined from IR measurements and are explainable in terms of classical unimolecular reaction kinetics. The data were correlated with the Rice-Ramsperger-Kassel (RRK) theory. Kinetic rates obtained from exponentially decaying radiation at 12.6 microns and temperatures of 2050 to 2800K are attributed to SF3 and lie near the low-pressure limit of unimolecular reactions. The SF3 dissociation rates are given. Author (TAB)

N70-40454# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
EXPERIMENTAL OBSERVATIONS AND MEASUREMENTS ON THE ARL Q-DEVICE
H. Anton and W. Friz Mar. 1970 37 p refs
(AD-708519; ARL-70-0037) Avail: NTIS CSCL 20/9

The behavior of the ARL Q-device is described for various operational conditions. The reported experiments do not constitute completed studies but are rather exploratory in nature and obtained results are to be considered as starting points for future investigations. Although the data so far measured do not suffice for a good quantitative description, an attempt has been made throughout the report to bring a logical and consistent causality into

the observed data. In this way one can classify three distinct oscillatory states from the experimental observations made on the Q-device: First, the clean interger harmonic frequency state. Second, the discrete frequency mode-coupling state. Third, the turbulent mixing state. These states are described in as much detail as available measurements at this time permit. Author (TAB)

N70-40475 City Univ. of New York.
EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE ONSET OF STATIONARY CONVECTIVE PLASMA CELLS
Joseph C. Cataldo (Ph. D. Thesis) 1969 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-19054

A low-beta collisional plasma cylinder confined in a uniform magnetic field is considered. A stationary convective instability, due to the relative rotation of concentric rings of plasma which leads to an adverse angular momentum between these rings, is studied. This mechanism produces a distinct stationary cellular pattern consisting of eight smaller cells around a large central circular hole at a critical magnetic field around 200 gauss. The theory of stationary convective instability is used to predict the structure and location of the plasma cells. A stream pattern is theoretically determined which matches the experimentally observed plasma cells. A relationship between the perturbed density and potential is also found to be in good agreement with the experimental values. Dissert. Abstr.

N70-40490 Carnegie-Mellon Univ., Pittsburgh, Pa.
THE EFFECT OF SIMON DIFFUSION ON A SHORT CROSS FIELD DISCHARGE
Joel Harris Fink (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-19091

A study is made of a short cross field discharge which consists of an axial arc in a parallel, uniform magnetic field, surrounded by a grounded cylinder and capped on each end with discs which are at some common positive potential. Following the analysis of a positive column in an axial magnetic field, use is made of diffusion equations. The result is a general equation which is applicable to any beam of charged particles moving through a plasma. The theory is compared with data collected in a series of experiments using separately metered, independent segments of the discharge wall as probes. The meters were photographed to provide simultaneous data. Dissert. Abstr.

N70-40526 Michigan Univ., Ann Arbor.
THE EFFECT OF SHEARED MAGNETIC FIELDS ON ION CYCLOTRON DRIFT INSTABILITIES
James Nari Davidson (Ph.D. Thesis) 1969 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-17988

The effect of magnetic shear on the stability of electrostatic oscillations in an infinite inhomogeneous isotropic plasma is investigated using the linearized Vlasov equations. For oscillations with frequency much smaller than the ion cyclotron frequency, a thorough examination of various approaches including normal mode analysis and the wave packet approach is given. A normal mode analysis is used to study the effect of shear on electrostatic drift modes with frequency near integral multiples of the ion cyclotron frequency propagating nearly normal to the magnetic field lines. The wave packet approach is then employed to investigate the stability of these high frequency oscillations when they propagate at an arbitrary angle to the field lines. For low density plasma, it is shown that the drift cyclotron modes are stabilized by approximately the same shear required to stabilize the low frequency modes, while at high densities, a more stringent shear is required for stabilization. Dissert. Abstr.

N70-40546 National Lending Library for Science and Technology, Boston Spa (England).
MEASUREMENT OF EXCITATION TEMPERATURES IN A HIGH-CURRENT HOLLOW CATHODE
P. A. Bueger et al Apr. 1969 16 p refs Transl. into ENGLISH from Z. Phys. (West Ger.), v. 218, 1968 p 248–260
(NLL-LB-G-284-0(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Measurements of excitation temperatures in the negative glow light of a high-current hollow cathode discharge lamp with a gas temperature of about 1500 K have shown values for T(sub a) of approximately 5000 K when the atomic spectral lines are used as indicator. However, from ionic lines a temperature of 30,000 – 100,000 K is deduced depending on the nature of the discharge gas. This big difference indicates that there is no Maxwell distribution in the hollow cathode discharge. A possible explanation could be that two energetically distinct types of electrons take part in ionization and recombination respectively. Author

N70-40571# Illinois Univ., Urbana. Gaseous Electronics Lab.
ELECTROSTATIC-INERTIAL PLASMA CONFINEMENT
Thomas J. Dolan, Joseph T. Verdeyen, Blake E. Cherrington, and Donald J. Meeker Jun. 1970 141 p refs
(Grant AF-AFOSR-1584-68)
(AD-708522; UILU-ENG-70-303; AFOSR-70-1656TR) Avail: NTIS CSCL 20/9

The work was directed towards an answer to the question: How dense a plasma can be confined by electrostatic-inertial means. Electrostatic-inertial plasma confinement consists of trapping charged particles in potential wells (of the electric field), which are produced by ions or electrons injected radially inwards into a hollow sphere or cylinder, called the grid. Theoretical expressions are derived for the potential, electron density and ion density as functions of radius, grid voltage and grid current. The main limitations on plasma density are summarized. A neon plasma was produced in cylindrical geometry. A device is proposed which could inject much higher currents at lower pressures. Author (TAB)

N70-40604 Wisconsin Univ., Madison.
VELOCITY DIFFUSION AND PLASMA CONFINEMENT IN MIRROR CONFIGURATIONS DUE TO ION CYCLOTRON INSTABILITIES
Mosi Chu (Ph.D. Thesis) 1969 80 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-12351

This investigation primarily concerns the diffusion rate of ions into the loss cone of open-ended containment devices and the estimate of the lifetime of plasma due to an ion cyclotron instability. For $T_i > T_e$, the ion distribution function in such devices is necessarily peaked around a non-zero perpendicular energy. Such a distribution invites instabilities. Velocity diffusion equations are formulated quasi-linearly and the ion cyclotron instability is discussed through the principle of conservation of energy. Two important phenomena arise due to this velocity diffusion process. (1) These low-energy ions eventually escape from the magnetic trap. (2) The presence of these low energy particles provides a very strong damping effect for the instability considered. As a result, an equilibrium is set up between velocity and coordinate space. An estimate of the plasma lifetime is derived from such an equilibrium configuration. This calculated lifetime is of the same order of magnitude as that observed in some experiments. Dissert. Abstr.

N70-40609# Stanford Univ., Calif. Inst. for Plasma Research.
THE COMPUTER SIMULATION OF A SPHERICALLY SYMMETRIC PLASMA
Christopher W. Barnes Mar. 1970 83 p refs
(Contract F44620-69-C-0007)
(AD-708523; SU-IPR-344; AFOSR-70-1006TR) Avail: NTIS CSCL 20/9

One-dimensional plasma problems with planar and spherical symmetry are studied by means of numerical simulation techniques. The finite length planar diode problem with a beam traveling through a neutralizing background of oppositely charged particles is treated and the effect of finite background mass and temperature on beam stability in this model is determined. Author (TAB)

N70-40616# Ohio State Univ. Research Foundation, Columbus.
ANALYSIS OF A RADIATION ABSORBING WALL-STABILIZED ELECTRIC ARC Final Report
P. F. Hodnett Wright-Patterson AFB, Ohio ARL Apr. 1970 26 p refs
(Contract F33615-67-C-1758)
(AD-708732; ARL-70-0065) Avail: NTIS CSCL 20/3

A theoretical investigation is undertaken of an electric arc confined in a circular cylindrical tube when conditions are such that the arc absorbs as well as emitts radiation. Since theoretical expressions exists for the transport properties of argon, the gas in the arc is taken to be argon but the method of analysis is also valid when other gases are considered. The solution to the set of integro-differential equations which describes the problem is sought by an iterative method. Author (TAB)

N70-40742# Army Electronics Command, Fort Monmouth, N.J.
MOLECULAR IONIZATION IN CESIUM
Stephen Levy May 1970 57 p refs
(AD-708870; ECOM-3291) Avail: NTIS CSCL 7/4

The objective of the study was to identify the cesium ionization mechanism in an environment which impedes contact ionization, thermionic emission and single-stage ionization. A cesiated ceramic tube, in the form of a long cylinder, was heated by a carbon furnace surrounding the central portion of the tube. The ceramic temperature (1023 - 1773K) and cesium pressures (0.02 to 25.0 torr), used in this experiment, were chosen to coincide with thermionic converters operating in the low voltage arc mode. Current was observed when voltage was applied along the tube axis. The current, corrected for wall leakage, agreed with a model based on molecular cesium ionization produced by a two-body collision. Author (TAB)

N70-40744 Purdue Univ., Lafayette, Ind.
DISPERSION RELATIONS FOR A COLLISIONLESS PLASMA IN AN APPLIED MAGNETIC FIELD
James Alec Weber (Ph.D. Thesis) 1969 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-17289

The problems of transverse and longitudinal wave propagation through an infinite, unbounded, collisionless plasma immersed in an applied magnetic field are examined using the Maxwell equations of electromagnetic field theory and the Boltzmann equation statistical description of the plasma. Based on an initial value formulation, the distribution functions and electromagnetic fields are shown to evolve from their initial value. The methods of Laplace and Fourier transform analysis are used in seeking the dispersion relations. Plane wave solutions are sought. Special attention is given to the dispersion relations which must be satisfied in order for plane wave solutions to exist. It is demonstrated that for cases of purely transverse modes, the method gives the same results as does the method of linearizing the distribution function within the Boltzmann equation when the distribution function is isotropic. Dissert. Abstr.

N70-40763# Gulf General Atomic San Diego, Calif.
FLOW OF HIGH-DENSITY IRON PLASMA IN GAS-FILLED PIPES AND MUFFLERS Final Report, Feb. - Sep. 1969
H. R. Kratz Oct. 1969 56 p refs
(Contract DASA01-69-C-0072)
(AD-708435; GA-9883; DASA-2439) Avail: NTIS CSCL 20/9

An experimental program was conducted to investigate the flow of high-density, high-velocity iron plasma in gas-filled mufflers and pipes. The experiments were directed toward the investigation of: (1) the flow of plasma through gas-filled mufflers, (2) the flow of plasma in gas-filled pipes without mufflers, and (3) the rapid filling of an evacuated tank with detonation products by detonating high explosive within the tank. The experimental results indicate that filling a muffler with gas does not increase its effectiveness over that of an evacuated muffler and may even decrease its effectiveness. The results show, however, that filling a straight pipe with gas increases the rate of momentum transfer and loss of kinetic energy to the pipe. The results also show that a concentrated slug of plasma is produced on partial stagnation of the plasma by the gas and that the slug loses mass during the early part of its travel down the pipe and gains mass further down the pipe after it has cooled. Possible mechanisms for the loss and gain in mass as well as the transfer of momentum to the pipe are discussed. Author (TAB)

N70-40979*# Stanford Univ., Calif. Inst. for Plasma Research.
ON THE THEORY OF POLARIZATION TRANSFER IN INHOMOGENEOUS MAGNETIZED PLASMAS
Y. C. Chin and P. C. W. Fung Aug. 1970 21 p refs
(Grants NGR-05-020-272; NGL-05-020-014; NSF GA-1148; Contract F44620-69-C-0008)
(NASA-CR-113823; SU-IPR-378) Avail: NTIS CSCL 20I

The theory of polarization transfer in an inhomogeneous magnetized plasma medium is extended to include the effects of the mode-coupling phenomenon. The resultant system of polarization transfer equations is analyzed for several special cases of interest. Author

N70-41071# Ion Physics Corp., Burlington, Mass.
DIAGNOSTICS AND APPLICATIONS OF PULSED SELF-FOCUSED RELATIVISTIC ELECTRON BEAMS Final Report, 1 Mar. - 31 Dec. 1969
Stewart Graybill, Joseph Rizzo, John Uglum, and William H. McNeil Jun. 1970 148 p refs
(Contract DA-49-146-XZ-553)
(AD-709118; DASA-2477) Avail: NTIS CSCL 20/7

Field emission diode diagnostics were extended to include a capacitive voltage monitor which was used in conjunction with the existing current monitor to provide complete time resolved diode data. This included Z and nu/gamma as a function of time. The diode diagnostics were bench calibrated and cross-checked with the beam diagnostics with good agreement. The results of this part of the program were: data on the cathode plasma formation time for various cathodes, closure times, and impedance dependence on gap geometry. Beam energy propagation and front velocity measurements were made for beams with nu/gamma less than and greater than one. It is shown that a beam can be transported with low loss and little spectral degradation in the one Torr pressure region. Both accelerating and decelerating beam fronts were observed depending on pressure. Author (TAB)

N70-41162# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
RESEARCH ON ADVANCED GASDYNAMIC FACILITIES Quarterly Progress Report, 11 Sep. - 10 Dec. 1969
Wright-Patterson AFB, Ohio ARL Feb. 1970 34 p refs
(Contract AF 33(615)-5389)
(AD-709210; ARL-70-0027; QPR-14) Avail: NTIS CSCL 14/2

Progress is reported on a research program which has the objective of investigating new techniques for producing hypervelocity flows in aerodynamic test facilities. One phase is a study utilizing high peak-power lasers and another phase is a study of the isentropic-compression tube. Both of these approaches are being considered as possible means of heating and accelerating test gases. Author (TAB)

N70-41174# National Research Council of Canada, Ottawa.
LIGHT MIXING IN FINITE PLASMA VOLUMES [LICHTMISCHUNG IN ENDLICHEN PLASMAVOLUMEN]
A. Salat 1970 14 p refs Transl. into ENGLISH from Z. Naturforsch. (Tuebingen), v. 20a, No. 3, 1965 p 689-695
Supported in part by EURATOM
(NRC-TT-1415) Avail: NTIS

A third order scattering process of laser light in a fully ionized plasma is considered. Two laser beams may cause the plasma to oscillate with relatively high amplitude if the difference of their frequencies approaches the electron plasma frequency. The light of either one of the beams or of a third beam may be scattered by the induced fluctuations. The plasma is described macroscopically by a cold electron fluid. Special emphasis is given to the finite dimensions of the scattering volume. The results give detailed information about the angular width and intensity of the scattered light. Marked differences in the use of a two and a three laser system are pointed out, the former giving less intensity, the latter being more difficult to realize experimentally. Author

N70-41180*# Utah State Univ., Logan. Dept. of Mechanical Engineering.
A THEORETICAL STUDY OF HALL PARAMETER MEASUREMENTS WITH AN IMMERSIBLE THREE-COIL CONDUCTIVITY/VELOCITY PLASMA PROBE Final Report, 1 Oct. 1969 - 1 Apr. 1970
Edward Vendell 12 Jun. 1970 13 p refs
(Grant NGR-45-002-014)
(NASA-CR-113866) Avail: NTIS CSCL 20I

The purpose of this study is to determine if a three coil plasma probe can be used to take meaningful conductivity and velocity data measurements in a plasma when the only externally applied field is a large dc magnetic field. Author

N70-41214# TRW Systems Group, Redondo Beach, Calif. Electric Propulsion Technology Dept.
INDUCTIVE PULSED PLASMA CURRENT SHEETS Final Report
C. L. Dailey Jun. 1970 53 p refs
(Contract F44620-68-C-0042)
(AD-709686; AFOSR-70-1730TR) Avail: NTIS CSCL 20/9

A detailed set of probe measurements and a laser light scattering measurement of electron density have been made in the current sheet produced by a pulsed inductive accelerator. The purpose of the investigation was to formulate a physically valid description of the processes within the current sheet. It has been shown that the discharge consists of a thin flat disc of pure j sub theta current having nearly constant properties over the accelerator diameter. The only current carriers are electrons. The gas is ionized and swept up into a 4 mm thick plasma layer near the center of the current sheet. Ion acceleration is by axial charge separation electric field that is effective ahead of the mass layer only, where it is produced both by electron current and by a strong negative electron pressure gradient. On the accelerator coil side of the mass layer the positive electron gradient is just supported by the current sheet body force and the accelerating electric field nearly vanishes. Both the light scattering measurement of densityand that calculated from probe data show that the plasma is mostly doubly ionized. Author (TAB)

N70-41441# Joint Publications Research Service, Washington, D.C.
PLASMA PHYSICS AND THE PROBLEMS OF CONTROLLED THERMONUCLEAR SYNTHESIS. HIGH-FREQUENCY PROPERTIES OF PLASMA
V. T. Tolok, ed. 1968 227 p refs Transl. into ENGLISH of "Fizika Plazmy i Problemy Upravlyaemogo Termoyademogo Sinteza. Vysokochastotnye Svoistva Plazmy" Kiev, Naukova Dumka, 1968
(AEC-TR-7146) Avail: NTIS

Twenty-two papers are presented on the hf properties of plasma, microwave methods in plasma diagnostics, and MHD and shock waves. NSA

N70-41495# Washington State Univ., Pullman. Dept. of Physics.
VACUUM AND SURFACE STUDIES CONCERNING PLASMA ENVIRONMENTS Annual Summary Report, Jun. 1969-Jun. 1970
E. E. Donaldson and M. J. Dresser Jun. 1970 30 p refs
(Contract AT(45-1)-1548)
(RLO-1548-23) Avail: NTIS

Studies are described in the following order: (1) ion burial and thermal release from niobium single crystals, (2) electron impact desorption, (3) adsorption and total uptake of hydrogen by niobium, (4) scattering of molecules from surfaces, and (5) etching reactions at surfaces. NSA

N70-41498# Princeton Univ., N.J. Plasma Physics Lab.
THERMAL DIFFUSION IN A HIGHLY-IONIZED PLASMA COLUMN
B. Stefanov Apr. 1970 21 p refs
(Contract AT(30-1)-1238)
(MATT-758) Avail: NTIS

The flow of heat along a highly ionized plasma column is analyzed theoretically. The diffusion of a locally applied temperature disturbance is shown to be accompanied by a potential disturbance of approximately the same phase. Calculations of the phase lag of the temperature wave are presented and compared with measurements in a highly ionized cesium plasma column. The measured thermal diffusivity agrees with theory within 20%. Author (NSA)

N70-41498# Sandia Corp., Albuquerque, N.Mex.
A ONE-DIMENSIONAL ELECTRO-STATIC PIC CODE
J. W. Poukey Jun. 1970 32 p refs Sponsored by AEC
(SC-RR-70-314) Avail: NTIS

A one-dimensional PIC code, suitable for certain problems involving electron beams and/or plasmas, was developed. The code follows a large number of charged particles as they move self consistently in their own electric field. These particles are located between two infinite plates with a fixed distance and potential difference between them. The code is described and its limitations discussed. Results are presented of applying the code to several problems, notably a space-charge flow and a beam-plasma problem. Author (NSA)

N70-41584# Stanford Univ., Calif. Inst. for Plasma Research.
STUDIES OF PLASMA OSCILLATIONS Status Report, 1 Aug. 1969 - 31 Jan. 1970
F. W. Crawford Feb. 1970 54 p refs
(Contract AT(04-3)-799)
(SU-IPR-357; SR-35) Avail: NTIS

Results of experimental and theoretical research are presented on each of the following: low-frequency wave propagation and positive column instabilities, electron cyclotron echoes and collision measurements, wave-wave interaction phenomena, and beam-plasma interactions. NSA

N70-41603# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
INTERPRETING SPHERICAL LANGMUIR PROBE DATA FOR THE COLLISIONLESS CASE
E. L. Battle and R. P. Couch 1970 8 p refs
(AD-709185; AFIT-TR-70-5) Avail: NTIS CSCL 20/9

Techniques previously developed make it possible to reduce the interpretation of experimental Langmuir probe data to the reading of a single graph. The experimenter simply measures the electron temperature and one other parameter. The figures included

in the document may then be consulted and the plasma potential and ion number density read directly therefrom without any iteration.
Author (TAB)

N70-41612# Oak Ridge National Lab., Tenn. Thermonuclear Div.
TURBULENT ION HEATING IN BURNOUT 5
M. Widner Jul. 1970 18 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3036) Avail: NTIS

Some of the fundamental equilibrium properties, such as dc electric fields and cross-field drifts, are calculated for Burnout 5. The probable ion-heating mechanism, an instability resulting from a relative cross-field drift between ions and electrons, is evaluated, predicting growth rates on the order of omega (sub pi).
Author (NSA)

N70-41614# Army Electronics Command, Fort Monmouth, N.J.
CHARACTERISTICS OF INERT-GAS DISCHARGES DURING SHORT PULSE OPERATION
William H. Wright, Jr. Jun. 1970 24 p refs
(AD-709593; ECOM-3295) Avail: NTIS CSCL 20/9

Inert-gas arc discharges were investigated to determine their spectral and electrical characteristics under the conditions of short-pulse, high-current-density, repetitive operation. The gas fills used were xenon, krypton, and argon at pressures in the order of one atmosphere. The discharges were operated at current densities of up to 25,000 A/sq centimeters, corresponding to a peak power level of 45 MW. At a current density of 3,500 A/sq centimeters, the discharges show strong line radiation superimposed on the continuum, but at 25,000 A/sq centimeters the radiation is predominantly continuum. At the high current densities the properties of the various gases tested were similar. Approximately 18% of the peak input power is radiated in the band from 2250A to 10,000 A. Only 2% of the input power is radiated in the pumping bands of the Nd(3+) ion. The resistivity of the discharge at the high current density is approximately .01 ohm-cm. Author (TAB)

N70-41628* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ELECTRIC ARC DEVICE FOR HEATING GASES Patent
William C. A. Carlson and Carl E. Sorensen, inventors (to NASA)
Issued 11 Jan. 1966 (Filed 20 Dec. 1960) 8 p Cl. 315-111
(NASA-Case-XAC-00319; US-Patent-3,229,155;
US-Patent-Appl-SN-77251) Avail: US Patent Office CSCL 13A

A method is described for minimizing electrode ablation and increasing the efficiency of an electric arc device used to heat gasses or plasmas to extremely high temperatures. The described device is capable of heating gases at a volumetric rate to a temperature suitable for use in supersonic or hypersonic wind tunnels. The gases are heated as they pass through the region of an electric arc from two or more electrodes. A magnetic field is generated at each electrode by a solenoid coil having an axis parallel to the direction of arc discharge from the electrode. The magnetic field causes the power in the arc to be more uniformly distributed over a large electrode area and also produces fringing components which cause the multiple spot diffuse arc to rotate, thus reducing electrode ablation and increasing the heating efficiency.
R.B.

N70-41632# Auburn Univ., Ala. Engineering Experiment Station.
INVESTIGATION OF THE INCEPTION PHASE OF ATOM-ATOM IONIZATION IN THE RARE GASES Final Report, 1 Jul. 1965 – 30 Sep. 1969
Kenneth E. Harwell and Kenneth O. West Jun. 1970 138 p
(Contract DA-31-124-ARO(D)-381)
(AD-709701; AROD-5571.1-E) Avail: NTIS CSCL 7/4

The inception phase of shock-heated krypton was investigated in a two inch square aluminum shock tube using two transverse microwave probes operating at 9.8 GHz and 14.7 GHz. Shock waves of Mach number 7.5 to 10 were propagated into ambient krypton at pressures of 5, 10, and 20 torr. Gas temperatures produced were between 5750K and 7850K. Shock tube impurity levels were in the 0.0000001 range which were well below impurity levels of the research grade test gases as analyzed using a mass spectrometer. The microwave data were reduced to yield the free electron density and effective electron collision frequency variation after passage of the shock wave. An electrostatic probe was also used to measure electron density for a few experiments. The electrostatic probe data agreed with the microwave data after the probe data were corrected for Debye shielding effects.
Author (TAB)

N70-41665# Army Electronics Command, Fort Monmouth, N.J.
HOLLOW-BEAM-GENERATED PLASMA
Maurice Weiner Jun. 1970 21 p refs
(AD-709594; ECOM-3300) Avail: NTIS CSCL 20/9

Theoretical plasma density and potential radial profiles are derived for plasmas generated by a hollow electron beam. Both collision-dominated (with neutral atom) and collisionless plasmas are considered. Separate solutions of the region occupied by the cylindrical beam and the central region are first obtained. The two solutions are then matched at the inner radius of the beam to obtain the complete solution. Results indicate that plasma in the central region has essentially constant density and potential, while in the beam region both density and potential decrease monotonically with increasing radius. It is argued that the absence of any plasma particle sources or sinks in the central region is responsible for the relatively uniform plasma. Experimental results on a Penning Ionization Gauge discharge with an annular ring-shaped emitter confirm the uniform properties of the plasma in the hollow region.
Author (TAB)

N70-41764# Wisconsin Univ., Madison. Dept. of Electrical Engineering.
PLASMA INSTABILITIES AND WAVES EXCITED BY AN ANISOTROPIC ENERGY DISTRIBUTION PRODUCED BY ELECTRON CYCLOTRON RESONANCE Quarterly Progress Report
J. L. Shohet, J. C. Sprott, and S. R. Seshadri 15 Jun. 1970 44 p refs
(Contract AT(11-1)-1695)
(COO-1695-27; QPR-13) Avail: NTIS

Computer simulation of electron cyclotron heating and of rf confinement was extended. The effect of varying the plasma density, and hence the importance of space charge electric fields, was studied. Calculations of the free–free bremsstrahlung from an anisotropic, relativistic plasma were continued. The validity of the various approximations used in the derivation was studied, and corrections made for the finite mass of the nucleus. Calculations of the polarization of the bremsstrahlung were carried out, and this promises to be a useful tool for determining plasma anisotropy. The experimental program was enhanced by improving the reproducibility of the plasma by reducing the ripple on the magnetic field and magnetron high-voltage supply by an order of magnitude and by the construction of a 50-watt cw microwave source. Measurements of the heating efficiency were made in order to compare with previous theoretical predictions. Flute instabilities were observed and studied.
Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 18 Masers. For related information see also: 10 Electronics.

N70-40427 California Univ., Riverside.
OPTICAL PROPERTIES OF ALPHA MnSe
Donald Louis Decker (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-19124

Near normal incidence reflectance measurements are reported on the face centered cubic phase of MnSe from 0.006 ev to 16 ev. The reflectance samples included epitaxial single crystal films and polycrystalline films deposited on smooth glass substrates. The complex index of refraction and the complex dielectric constant were obtained from a phase shift dispersion analysis of the reflectance data. An extrapolation derived from the harmonic oscillator dispersion model was used to extend the data in the infrared, and a modified Roessler extrapolation was utilized in the analysis of the ultraviolet reflectance data. The first order infrared absorption (Reststrahl) was analyzed, and the second order Reststrahl structure was related to multiphonon absorption. The ultraviolet dispersion was correlated with single electron interband transitions and many body excitations. A simple electron energy level diagram is proposed. Transmission data is also reported over the range 0.04 ev to 2.8 ev down to 80 deg K. Dissert. Abstr.

N70-40436# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
PIEZOELECTRIC SURFACE WAVES ON FREE AND METALLIZED SURFACE OF LiNbO3
Ronald N. Spaight Mar. 1970 15 p refs
(Contract F33615-68-C-1034)
(AD-708710; ERI-70300) Avail: NTIS CSCL 20/12

Propagation velocity, displacement amplitude, and electric field amplitude variations for a free and metallized surface on LiNbO3 were considered. The results indicate coupling to be stronger in LiNbO3 than other reported piezoelectrics. These results indicate the electromagnetic to acoustic energy conversion efficiency of interdigital transducers should be greater on LiNbO3 as has been experimentally observed by various investigators. The input resistance was calculated and the results indicated less than 3% power reflection for the case considered. Author (TAB)

N70-40455# California Univ., Los Angeles. Dept. of Physics.
THEORETICAL STUDY OF THE MAGNETIC PROPERTIES OF SOLIDS Final Report, 1 Sep. 1963–31 Oct. 1969
Raymond Orbach and Philip Pincus 31 Oct. 1969 33 p refs
(Contract Nonr-233(88))
(AD-709076) Avail: NTIS CSCL 20/12

The absorptive and dispersive components of the magnetic susceptibility at microwave frequencies is calculated for dilute magnetic alloys. A complete response theory is developed which exhibits the magnetic resonance bottleneck, as well as the frequency dependence of the loss rates. Magnetic colloids are examined with reference to non-mechanical pumps. Liquid ferromagnets are demonstrated to have Block walls of infinite thickness, with no conventional domain structure. The response of an isolated uniaxial magnetic grain suspended in a liquid to an applied rotating rf field is calculated. In a large static magnetic field, a critical frequency obtains below which a steady state is reached, but above which the mechanical behavior depends crucially on the initial conditions. A theory is developed for the determination of the orientational order in liquid crystals using magnetic resonance. Energy transfer in laser materials is studied. Special attention is given to the ability of loss centers to communicate with the bulk single ions in the presence of inhomogeneous broadening. It is demonstrated that a critical concentration exists below which this communication is impossible, and above which communication is rapid. A superexchange model is used for the single ion-single ion coupling. Author (TAB)

N70-40459 Missouri Univ., Rolla.
LONGITUDINAL OPTICAL PHONON-PLASMON COUPLING IN IONIC SEMICONDUCTORS
Thomas Joseph McMahon (Ph.D. Thesis) 1969 58 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19430

The coupling of free carriers and lattice vibrational modes is studied in CdS and InSb by room temperature far infrared reflectance measurements. When the free carrier concentration is such that the plasma frequency is at or near the longitudinal optical mode frequency it is shown that while the transverse modes remain fixed, the longitudinal modes mix with the plasma mode and are shifted in a manner similar to that described by Varga in 1965. Using the dielectric function for the coupled system permits the determination of electron effective masses by reflectance measurements with lattice effects excluded. This method permits the investigation of the frequency shifts and effective mass values on crystals in which the mobility varies by more than an order of magnitude as demonstrated by the analysis of both CdS and InSb. In the case of CdS where the polaron coupling constant is large enough to have noticeable effects, account is taken of the polaron mass and of the additional absorption in the plasma mode at frequencies above the longitudinal optical phonon frequency. Dissert. Abstr.

N70-40480 Michigan Univ., Ann Arbor.
STUDY OF THE LATTICE DYNAMICS OF DEUTERATED POLYETHYLENE AND ZINC SULFIDE USING COHERENT NEUTRON SCATTERING
Lee Albert Feldkamp (Ph.D. Thesis) 1969 269 p
Avail: Univ. Microfilms: HC $12.15/Microfilm $3.50 Order No. 69-17998

The technique of coherent inelastic scattering of thermal neutrons was used to study the lattice vibrations of deuterated polyethylene and zinc sulfide. In the case of polyethylene, a stretch-oriented target was utilized because of the present nonexistence of sufficiently large single crystals. Dispersion curves for two branches with wave vectors parallel to the direction of the chain axis were measured. These data represent the first direct dispersion curve determination in a polymer. The acoustic branches in the three principal symmetry directions of zinc sulfide were measured and were found to resemble those of similar materials. On the basis of the zone boundary acoustic frequencies determined, a tentative set of assignments of events seen in infrared absorption and Raman scattering spectra is presented. Dissert. Abstr.

N70-40488 Carnegie-Mellon Univ., Pittsburgh, Pa.
De HAAS-VAN ALPHEN EFFECT IN n-TYPE Bi_2Te_3
Richard Bailey Mallinson (Ph.D. Thesis) 1969 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-17506

The de Haas-van Alphen effect was measured in n-type Bi_2Te_3 with carrier concentrations ranging from 9×10 to the 17th power to 2.4×10 to the 19th power/cu cm. Below 5×10 to the 18th power/cu cm the conduction band minima can be fitted to a six ellipsoid model, the parameters of which differ considerably from those inferred from magnetoresistance experiments. The carrier density computed from the volume of the ellipsoids agrees well with that obtained from the limiting high-field Hall coefficient at 4.2 K. At higher concentrations there is a large discrepancy between the two estimates of carrier density. The presence of a low mobility, high mass band, lying 30 meV above the ellipsoidal parameters deduced from the de Haas-van Alphen and transport measurements. Dissert. Abstr.

N70-40541# Army Electronics Command, Fort Monmouth, N.J. Power Sources Div.
SPECTRAL EMITTANCE OF NEODYMIUM, SAMARIUM, ERBIUM AND YTTERBIUM OXIDES AT HIGH TEMPERATURES
Guido E. Guazzoni and Stuart J. Shapiro May 1970 45 p refs
(AD-708547; ECOM-3281) Avail: NTIS CSCL 20/12

Spectral emittance of solid specimens of Er2O3, Yb2O3, Sm2O3 and Nd2O3 was obtained by comparison of sample emission with the emission of a standard black body cavity maintained at the same sample true temperature. The spectral emittance has been characterized in a wavelength range of 0.4 - 5.0 micrometer and at sample temperatures from 1520K up to 1870K corresponding to surface radiation flux densitites of 10 - 50 W/sq cm. This flux density range is of practical interest for thermophotovoltaic energy conversion applications. Preliminary observations of spectral transmittance and reflectance are also reported. Author (TAB)

N70-40550# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RESONANT AMPLIFICATION AND COUPLING OF ACOUSTIC SURFACE WAVES WITH ELECTRONS DRIFTING ACROSS A MAGNETIC FIELD
Barry E. Burke and Abraham Bers 4 Feb. 1970 6 p
(Contract AF 19(628)-5167)
(AD-708592; JA-3662; ESD-TR-70-176) Avail: NTIS CSCL 20/12

It is shown that acoustic surface waves on a piezoelectric can be resonantly amplified by coupling to a weakly damped carrier surface wave on an adjacent semiconductor in which the conduction electrons are made to drift across an applied magnetic field. The conditions for such a wave-wave interaction are established, and calculations of the growth rate and its characteristics are given. Under the same conditions, reversing the direction of the magnetic field changes the amplifier to an almost loss-free, tunable, coupler. Author (TAB)

N70-40567 Massachusetts Univ., Boston.
ELECTRON-NUCLEAR DOUBLE RESONANCE IN RADIATION DAMAGED ACETYLGLYCINE
Richard Elliot Piazza (Ph.D. Thesis) 1969 59 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-19156

An electron spin resonance system was constructed for operation at a nominal frequency of 9 GHz with special attention paid to techniques which would yield high sensitivity and long term stability. Samples of acetylglycine ($CH_3CONHCH_2COOH$) were cleaved from crystals grown by slow evaporation of aqueous solution and radiation damage in these samples was effected by exposure to several million R of gamma rays from a 2.5 kilocurie Co^{60} source. The sample temperature was reduced to that of liquid nitrogen and ESR of $CH_3CONHCHCOOH$. A set of 13 lines was observed in the 8-25 MHz range investigated. Measurement of these ENDOR frequencies as a function of magnetic field direction was made for three planes through the sample and served to define two sets of coupling tensors. The sets of coupling tensors were observed to possess a twofold rotational relationship appropriate to the crystal structure of acetylglycine. The tensors were indicative of weak electron couplings to protons. Dissert. Abstr.

N70-40570# Trinity Coll., Dublin (Ireland). School of Engineering.
PRESSURE AND TEMPERATURE DEPENDENCE OF THE DIELECTRIC PROPERTIES OF THE N-ALKANES AND THE ALKALI HALIDES Final Scientific Report
B. K. P. Scaife 12 Apr. 1970 57 p refs
(Contract FA-EOOAR-68-0006)
(AD-708527; AFOSR-70-1844TR) Avail: NTIS CSCL 20/3

Measurements are reported of the temperature and pressure dependence of the permittivity of n-pentane, n-hexane, n-heptane, n-nonane and n-decane. Precision was plus or minus 2 parts in 10,000 in permittivity. The temperature range was - 20C to + 100C while the pressure range was 1 - 3,500 bars. Similar measurements are also reported for single crystal specimens of LiF, LiCl, NaF, NaCl, NaBr, KF, KCl, KBr, KI, RbCl, RbBr, RbI, CsBr and CsI and for compressed powder specimens of KBr and KCl. Values for temperature pressure coefficients of permittivity show wide scatter for single crystals but much smaller scatter for compressed discs. Author (TAB)

N70-40592# California Inst. of Tech., Pasadena.
STUDIES OF MAGNETIC FLUX REVERSAL Final Report
F. B. Humphrey 10 Jun. 1970 7 p
(Contract DAHC04-67-C-0012)
(AD-708908; AROD-6356.5-E) Avail: NTIS CSCL 20/3

Research was conducted to understand the dynamic magnetic characteristics of magnetic thin, single, and multiple layers structures. Especially those characteristics that are important to the use of these structures in digital circuitry were studied. The following accomplishments were made: (1) A multiple source evaporation system was developed; (2) Forty sets of samples were made of permalloy films with inclusioned gold; (3) The 180 degree pulse reversal time measuring equipment was modified to investigate faster reversal processes; (4) Ferromagnetic damping studies were made and compared with damping as observed in reversal experiments; (5) A detailed study of the width of a Bloch wall was made in the thickness region; and (6) Extensive treatment of the effect of crystalline anisotropy in poly-crystalline films as well as other material imperfections was made and characterized as ripple. Author (TAB)

N70-40611 Maryland Univ., College Park.
A STUDY OF MAGNETIC FIELD INDUCED SURFACE STATES IN METALS AND SEMIMETALS
James Darrell Jensen 1969 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-18540

The microwave surface impedance of bismuth, indium, and gallium was investigated at liquid helium temperature and in the frequency range 32-55 GHz. The derivative of the surface resistance (dR/dH) oscillates when a weak magnetic field is applied parallel to the surface. The derivative maxima correspond to transitions between pairs of allowed magnetic field induced surface states. The spectrum and lineshape of the transitions are given by the Prange-Nee theory. The relative positions of the resonance fields are the same for all metals and do not involve Fermi surface (FS) parameters. However, the absolute positions of the resonance fields could be calculated for bismuth since the relevant FS parameters are reasonably well known from de Haas-van Alphen and cyclotron resonance measurements. The good agreement between the resonance field calculated from the theory and the corresponding dR/dH maximum provides a detailed confirmation of the Prange-Nee theory. Dissert. Abstr.

N70-40622 Rice Univ., Houston, Tex.
RIGID DISK AND SPHERE SOLIDS AT HIGH DENSITIES
Walter Greyson Rudd (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilms $3.00 Order No. 69-19330

A formal derivation of an asymptotic expansion for the Helmholtz free energy F sub N for a system of N nu-dimensional rigid spheres of diameter sigma is given. Formal expressions for the numerical coefficients C, D, and E are derived, and the cell cluster technique is applied to the calculation of C and D in the two-dimensional triangular lattice and in the three-dimensional hexagonal-close-packed and face-centered-cubic lattices. The value of C is found for the tunnel model in the triangular and face-centered-cubic lattices. A comparison is made between the results of the above calculations and the results of computer experiments. Computational methods are described in full. Dissert. Abstr.

N70-40629# National Electrotechnical Inst., Turin (Italy).
THERMOLUMINESCENCE INDUCED BY ac ELECTRIC FIELD IN ELECTROLUMINESCENT ZnS(Cu)
Guido Bonfiglioli, Piero Brovetto, and Gianluigi Busca May 1970 32 p refs
(Contract AF-EOAR-70-0074)
(AD-708526; AFOSR-70-1843TR; SR-1) Avail: NTIS CSCL 20/6

Experiments have been performed on the Thermoluminescence (TL) due to Electroluminescent (EL) excitation of ZnS(Cu) single crystals. Two major glow peaks are found respectively at 35 and 100K, the first being characteristic of EL excitation. The measured activation energies of these glow peaks turn out to be 0.00361 eV and 0.0931 eV and the kinetics order approximately 0.5 and 1. The integrated light intensity of the first glow peak overcomes that of a single EL brightness wave at the same voltage by a factor of about 10,000. With reference to the EL model previously put forward by us these experimental results can be accounted for satisfactorily. The first peak in fact appears due to electrons trapped at the broken bonds lying along the EL defect and the second peak is produced by electrons scattered during the direct bias injection and successively trapped in the bulk ZnS. Author (TAB)

N70-40638 National Lending Library for Science and Technology, Boston Spa (England).
NATURE OF 'GROWTH BANDS' IN GaAsP EPITAXIAL LAYERS
F. A. Gimelfarb et al Apr. 1970 9 p refs Transl. into ENGLISH from Kristallografiya (Moscow), v. 14, no. 6, 1969 p 1104 - 1106
(NLL-RRE-Trans-274-(8036.625)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The increased concentration of arsenic and other impurities are studied in the region of growth bands from the GaAs substrate when GaP is grown exitaxially on single crystals of GaAs. It is concluded that small oscillations of pressure lead to noticeable changes in the structure and composition of the epitaxial layes. Arsenic vapor, which is formed by gaseous etching of the substrate, penetrates into the gap, and the surface layers of the growing crystal are enriched by arsenic. F.O.S.

N70-40639 California Univ., Berkeley.
MAGNETOTHERMODYNAMIC PROPERTIES OF CuK2(SO4)2-6H2O BETWEEN 0.5 and 4.2 K IN MAGNETIC FIELDS OF 0 TO 90,000 GAUSS PARALLEL TO THE b CRYSTALLOGRAPHIC AXIS
James Russell Lemley (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-18945

The heat capacity and magnetic moment of a 3.9-cm-diameter spherical single crystal of Cu Kw (SO4)2.6 H2O have been measured over the range 0.5 - 4.2 K with stabilized magnetic fields of 0, 0.5, 1.0, 2.5, 5, 10, 15, 25, 40, 65 and 90 KG directed along the b crystallographic axis. The observed heat capacity approached zero at 0.8 K and 90 kG providing a zero-reference for the electronic entropy. Measurements of temperature, using a sensitive carbon thermometer, versus field along adiabatics which intersected the isoerstedic heat capacity series connected the entropy at every field to the reference established at 90 kG. At the six lower fields where it was possible to estimate the tail of the electronic heat capacity extending above 4.2 K, the electronic entropy was found to be R in 2 within experimental accuracy. Dissert. Abstr.

N70-40683# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
ELECTROLYTIC BEHAVIOR OF CaF2 UNDER REDUCING CONDITIONS
J. W. Hinze and J. W. Patterson May 1970 34 p refs Submitted for publication
(Contract F33615-68-C-1034; Proj. Themis)
(AD-708711; ERI-74800) Avail: NTIS CSCL 20/12

Solid CaF2 was studied from 550 to 850C with fluorine chemical potentials ranging from Ni,NiF2 to Ca,CaF2 coexistence. Measurements of ac conductivity, dc polarization currents and galvanic cell emfs were performed in this domain of experimental conditions. Assessment of these measurements in terms of mixed conduction theory leads to the conclusion that the ionic transference number for CaF2 is essentially unity over the range of conditions studied and hence CaF2 may be employed as a solid electrolyte therein. Author (TAB)

N70-40731 National Lending Library for Science and Technology, Boston Spa (England).
LOSSES OF ARSENIC DURING THE GROWING OF MONOCRYSTALS GaAs
V. V. Rakov et al 8 Jun. 1970 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), v. 5, no. 6, 1969 p 1458 - 1459
(NLL-RRE-Trans-280-(8036.625)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The conditions for gas bubble formation and their removal from the gallium arsenide melt are analyzed. To determine the possible bubble formation regions, their existence conditions were examined in different phase boundaries, taking into account buoyancy and surface tension. The balance equations active in the bubble occurring at the gallium arsenide melt-flux interface and at the container-melt boundary are given. It was found that the bubble diameter capable of being detached from the crucible walls is equal to 8.3 mm and from the melt-flux 7.8 mm. It is concluded that the most probable place for bubble nucleation is the melt-flux interface, especially in the presence of slag impurities. A considerable part of the vapor pressure in the bubbles is due to water and oxygen. Therefore to exclude arsenic loss careful cleaning, degassing, and dehydration of the flux, crucible, and gallium arsenide is necessary. J.M.

N70-40745 Columbia Univ., New York.
AN INVESTIGATION OF THE EFFECTS OF CHARGED IMPURITIES ON THE SHAPE OF THE FUNDAMENTAL OPTICAL ABSORPTION EDGE OF GALLIUM ARSENIDE
Martin Alan Afromowitz (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-17570

An experiment is described which shows conclusively that the electron-phonon interaction cannot be invoked to explain the low-energy exponential tail on the fundamental optical absorption edge of GaAs. A Monte-Carlo computer model is developed which calculates, without the use of adjustable parameters, the effect of random electric fields, produced by charged impurities, on the shape of the absorption edge. This model, based on Redfield-s theory of the Internal Franz-Keldysh effect, is able to predict the observed exponential tails, for both compensated and moderately doped p-type material, and successfully reproduces the observed temperature and impurity concentration dependences of the shape of the edge. The magnitude of the predicted absorption coefficient at the energy gap does not agree well with experiment, however. This fact is most probably attributable to the neglect of the electron-hole interaction Dissert Abstr.

N70-40805# Illinois Univ., Urbana. Coordinated Science Lab.
RADIATION EFFECTS IN SEMICONDUCTING LASER MATERIALS Final Report, 1 Dec. 1968 30 Nov. 1969
W. Dale Compton and Byron T. Ahlburn Wright-Patterson AFB, Ohio ARL May 1970 44 p refs
(Contract F33615-69-C-1251)
(AD-708734; ARL-70-0076) Avail: NTIS CSCL 20/12

High resolution spectra of the spontaneous and stimulated luminescence in CdSe have been investigated as functions of excitation intensity and temperature. In addition to the spontaneous emission lines, numerous laser lines and their cavity modes have been observed. Some of the laser lines appear to be correlated with spontaneous emission lines reported and interpreted by other investigators. Two of these lines have been observed to saturate and then to disappear as the excitation intensity increases. In one sample, a pronounced shift of the cavity modes to shorter wavelength has been observed as the excitation is increased.

Preliminary investigations of the effects of bombardment with 1.5 MeV electrons on the luminescence have been made. These early observations indicate that irradiation with electrons shifts the laser action to shorter wavelengths. Author (TAB)

N70-40896# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
UNCOUPLED PIEZOELECTRIC SURFACE WAVE MODES
George Koerber Oct. 1969 21 p refs Submitted for publication
(Contract F33615-68-C-1034)
(AD-708706; ERI-587) Avail: NTIS CSCL 20/12

The article deduces the symmetry conditions that are necessary for the existence of uncoupled surface wave mode groups. The motivation for this is practical. Piezoelectric surface wave devices can be used for a wide range of microwave signal processing operations. In all of these the field at, or immediately outside, the surface must interact with a metallic or semiconductive structure. The design of such devices involves a choice of orientation of the surface relative to the crystallographic axes of the substrate, and a choice of direction for the acoustic path on the surface. An appreciation of the effectsof symmetry upon the modal composition of a surface wave can be of essential importance in making these fundamental design choices. Author (TAB)

N70-40919# Chicago Univ., Ill. James Franck Inst.
CRYSTAL STRUCTURES, THEIR DEFECTS AND TRANSFORMATIONS Final Report, 1 Jul. 1967 – 30 Jun. 1970
Charles S. Barrett Jun. 1970 8 p refs
(Contract DAHC04-67-C-0050)
(AD-708900; AROD-4886.32-MC) Avail: NTIS CSCL 20/2

The objective of this program was to increase the understanding of the crystal structure of solids, through research on structures and structural defects with X-ray, neutron and proton diffraction, with considerable emphasis on metals, semi-metals, and van der Waals solids in which structural changes occur at low temperatures. Author (TAB)

N70-41057# Stanford Research Inst., Menlo Park, Calif.
GROWTH, PROCESSING, AND CHARACTERIZATION OF BETA-SILICON CARBIDE SINGLE CRYSTALS Final Report, 9 Feb. 1967 – 22 May 1970
Arne Rosengreen May 1970 44 p refs
(Contract F19628-67-C-0243)
(AD-709257; AFCRL-70-0319)

Equipment and growth procedures for growing beta-silicon carbide epitaxially on beta-silicon carbide substrates from methyltrichlorosilane in a carrier gas of hydrogen is described. Hall and resistivity measurements and electron spin resonance measurements are discussed. The results show that the quality of the epitaxially grown material is comparable with that of the best solution grown crystals. Processing steps such as oxidation, masking, and etching have been performed and simple electroluminescent diodes have been fabricated. Author (TAB)

N70-41069# Virginia Univ., Charlottesville. Dept. of Physics.
FLUCTUATION OF THE ORDER PARAMETER IN A SUPERCONDUCTOR WITH MAGNETIC IMPURITIES
S. B. Nam 14 Jan. 1970 4 p refs
(Contract N00014-16-69-A-0429; Grant AF-AFOSR-1830-70; Proj. Themis)
(AD-708995; AFOSR-70-1911TR) Avail: NTIS CSCL 20/12

The effect of the fluctuation of the order parameter on the conductivity was calculated, using the time dependent Ginzburg-Landau equation for the order parameter in a superconductor with magnetic impurities. It was found that the excess conductivity due to the fluctuation, paraconductivity, increases with the strength of depairing. TAB

N70-41094# California Univ., Berkeley. Electronics Research Lab.
ELECTROMAGNETIC WAVE-CHANGE INTERACTION IN CROSSED FIELDS Quarterly Progress Report, 16 Jan. – 15 Apr. 1970
S. Swierkowski, C. W. Turner, and T. Van Duzer Jul. 1970 17 p refs
(Contract DAAB07-67-C-0227)
(AD-709630; ECOM-0227-9; QPR-9) Avail: NTIS CSCL 20/12

The purpose of the work on this contract is to investigate the interaction of electromagnetic waves and charge carriers in vacuum and solids. Efforts on the crossed-field InSb surface-wave amplifier have been devoted to device fabrication and evaluation 1of the dc flow conditions. It has been established that the chosen electrode configuration will give drift velocities more than sufficient to achieve amplification. Author (TAB)

N70-41105*# Tyco Labs., Inc., Waltham, Mass.
ELECTROLUMINESCENT LIGHT SOURCES Final Technical Report
R. O. Bell, S. C. Foote, C. B. Lamport, A. A. Menna, and G. A. Wolff Jul. 1970 60 p refs
(Contracts NAS12-2044; DAAK02-69-C-0071; N00140-67-C-0386)
(NASA-CR-113907) Avail: NTIS CSCL 20L

Ga sub x In sub 1-x P was selected from the various solid solutions of 3-5 compounds as the most promising material for an electroluminescent light source which would emit in the visible 5000- to 6500-A range. Solid crystal ingots 0.8 cm in diameter and up to 2.2 cm in length well grown by the traveling heater method (THM). A molten Ga sub y In sub 1-y solvent zone was moved, at a rate of 3 mm/day and a temperature of 1000 to 1050 C, through a loosely packed (GaP) sub x (InP) sub 1-x feed mix or through a GaP-InP couple of parallel, aligned crystal rods. For the growth of solid solution crystals of 37 and 70 mole % Ga content, respectively, solvent alloys of initial GaP content of 20 and 35 mole % Ga were used. An exploratory experiment indicated the feasibility of seeding with GaP crystals. Optical transmission data taken from separate samples showed axial as well as radial homogeneity. An axial homogeneity of 41 + or mole % GaP over the tested two-thirds of an 18 mm region was found for one sample, while the major part of the cross section of another sample showed a composition of 53 + or – mole % GaP. X-ray measurements confirmed the general composition range determined optically. A new technique for the rapid determination of (111)-twinned grains in the unseeded growth of (Ga,In)P was derived. Author

N70-41132# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
NEW DERIVATION OF A THEORY ON QUANTUM CRYSTALS
William J. Mullin 30 Jun. 1970 15 p refs
(Contract N00014-67-A-0230-0003)
(AD-708417) Avail: NTIS CSCL 20/12

A new variational-cluster expansion derivation of Guyer's theory of the ground-state of a quantum crystal is presented. The results are identical with his in the two-body correlation approximation except that the variational approach provides a justification of the minimization technique used to choose the unperturbed Hamiltonian. The treatments differ in the higher correlation terms because of the use of a Jastrow trial function. Author (TAB)

N70-41203# National Research Council of Canada, Ottawa (Ontario).
METHODS FOR EXAMINATION OF CLASSIFYING CRYSTALLIZERS [UNTERSUCHUNGSMETHODEN FUER DIE KLASSIFIZIERENDE KRISTALLISATION]

Guenther Matz 1970 87 p refs Transl. into ENGLISH from Waerme, v. 70, no. 3-4, 1963 p 99-107, 137-152
(NRC-TT-1411) Avail: NTIS

Crystallization in fluidized beds is studied for producing coarse-grained products of uniform size. Crystal growth which is distinguished from nucleation occurs in two stages. The solute diffuses out of the supersaturated solution through the diffusion layer to the boundary layer around the crystals, and this is followed by the incorporation into the crystal lattice. Either of these steps may determine the rate of crystal growth. Several basic relationships are developed for estimating the height and diameter of fluidized beds on the basis of empirical values, and the hydrodynamics of the fluidized bed are analyzed. Crystal size and sedimentation velocities, measurement of the void fraction, and the measurement of the rate of nucleation are discussed. The results are in agreement with those of other experiments. F.O.S.

N70-41209# Cornell Univ., Ithaca, N.Y. Materials Science Center.
[SUMMARIES OF RESEARCH OBJECTIVES AND PROGRESS IN VARIOUS ASPECTS OF MATERIALS SCIENCE] Annual Technical Progress Report, 1 Jul. 1968-30 Jun. 1969
30 Jun. 1970 147 p refs
(Contract ARPA SD-68)
(AD-709117; MSC-1380) Avail: NTIS CSCL 11/7

Presented are the summaries of the 1968/1969 research efforts of the individual Members of the Materials Science Center. Where appropriate, a Members total research program is subdivided into separate research projects, which form distinct units characterized by specific titles. These summaries contain the names of the research associates and research assistants associated with each Member, as well as a list of reports, publications and theses submitted for Ph.D. or M.S. degrees during 1968/1969. Author (TAB)

N70-41247# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
THEORETICAL STUDIES OF QUANTUM SOLIDS AND LIQUIDS Final Report, 1 Apr. 1968-30 Jun. 1970
William J. Mullin 30 Jun. 1970 15 p refs
(Contract N00014-67-A-0230-0003)
(AD-708418) Avail: NTIS CSCL 20/12

The final report summarizes research performed under Office of Naval Research Contract N0001467-A-0230-0003 for the period 1 April 1968 to 30 June 1970 on Theoretical Studies of Quantum Solids and Liquids. Research is described on the phase separation in solid H2 - D2 mixtures, a cell model description of the crystalline state and the Bose Einstein condensed states of a quantum system, dilute liquid mixtures of 3He in 4He, and a new derivation of Guyers theory of the ground-state of a quantum crystal. Author (TAB)

N70-41265# Ohio State Univ. Research Foundation, Columbus.
THE CHARGE MECHANISM IN FERROELECTRICS Final Report, 13 Apr. 1968-12 Apr. 1970
Donald D. Glower and John B. Burt Mar. 1970 6 p refs
(Contract DA-ARO(D)-31-124-G981)
(AD-709694; AROD-6708-3-E) Avail: NTIS CSCL 20/12

Four compositions of lead zirconate titanate having different zirconium-titanium molar concentrations have been studied in an attempt to resolve the dominant conducting species and any dependence exhibited by this species as the material is subjected to various temperatures and oxygen concentrations. Author (TAB)

N70-41277# Technische Univ., Berlin (West Germany).
OPTICAL AND ELECTRICAL STUDIES ON BISMUTH TRISELENIDE Bi2Se3 [OPTISCHE UND ELEKTRISCHE UNTERSUCHUNGEN AM WISMUTTRISELENID Bi2Se3]
Seigfried Seech (Ph.D. Thesis) 1968 106 p refs In GERMAN
(D-83) Avail: NTIS

The production of single crystals and evaporated films of bismuth triselenide was investigated by electrical and optical measurements. Single crystals of various combinations in the range of 50 to 60 at. wt. % Se were grown, with no homogeneous crystals being found. Those crystals with a bismuth deposit on the outer surface were not used in the studies. The crystals with an excess of selenium deposit were homogeneous throughout and showed a strong dependence of the investigated electrical and optical properties on the selenium doping. Uniform effects were observed in stoichiometrically combined single crystals, which were annealed after production in a selenium atmosphere. Transl. by R.B.

N70-41287# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
THE TWO PART EQUATION FOR THE EXCITON [DIE ZWEITEILCHENGLEICHUNG FUER DAS EXZITON]
Klaus Dos (Ph.D. Thesis) 1968 83 p In GERMAN
Avail: NTIS

Mathematical formulas for determining the properties of excitons are presented. The exciton is a combination of an electron and a hole in a semiconductor or insulator in an excited state. The hole behaves as a positive charge and the electron is attracted to it to form a state similar to a hydrogen atom. The probability of the electron falling into the hole is limited by the difficulty of losing excess energy so that the excitation may have a relatively long life. The excitation of these states may be inferred from the absorption of light associated with their excitation. Excitons are termed either as Frenkel type (localized) or Mott-Wannier (delocalized). Transl. by P.N.F.

N70-41363# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
ON CRYSTAL-CHEMICAL, ELECTRONIC, AND INFRARED SPECTROSCOPIC STUDIES OF MIXED CRYSTAL SYSTEMS Zn(Zn SUB x V SUB 2-x)O4, LiZn SUB 1-x(V2)O4 AND Li SUB x Mn SUB 1-x(V2)O4 [UBER KRISTALLCHEMISCHE, ELEKTRONISCHE UND INFRAROTSPEKTROSKOPISCHE UNTERSUCHUNGEN AN DEN MISCHKRISTALLSYSTEMEN Zn(Zn SUB x V SUB 2-X)O4, Li SUB x Zn SUB 1-x(V2)O4 UND Li SUB x Mn SUB 1-x(V2)O4]
Klaus Mueller (Ph. D. Thesis) 1968 114 p refs In GERMAN
Avail: NTIS

Infrared spectroscopy was used to determine the relationship between crystal-chemical and electronic properties of the mixed crystal series and for measuring the spectra of vanadium (III) spinels MeV2O4 (Me= Co, Zn, Fe, Mn, Cd). A high temperature phase for the system Zn(Zn sub x V sub 2-x)O4 was found that did not change much with x, whereas a group of tetragonal superimposed spinel structures were observed at low temperatures. IR spectra of both, the high and low temperature phases, did not differ from each other in line positions and line numbers. The critical distance R between cations on octahedra points fell short in the mixed crystal series Li sub x Zn sub 1-x (+3V sub 2-x+4V sub x)O4 so that the system exhibited p-conductivity at x = 0.55. Specific resistance decreased with increased x values; conductance energies up to x=0.50 were about 0.15 eV and decreased after that point. It was shown that absorption spectra without structure were typical for metallic oxide phases and established the existence of free charge carriers. Infrared spectra proved the transfer from semiconducting to metallic behavior in the system Li xub x Mn sub 1-x (V2)O4 for x=0.5 to 0.8. Transl. by G.G.

N70-41389# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
THE PHOTOEMISSION CAPACITY OF PURE SINGLE CRYSTAL SURFACES OF LEAD, MERCURY, AND BISMUTH SELENIDE [UEBER DAS PHOTOEMISSIONSVERMOEGEN REINER EINKRISTALLOBERFLAECHEN VON BLEI-,

QUECKSILBER- UND WISMUTSELENID]
Hans-Eberhard Bergt (Ph.D. Thesis) 1968 87 p refs In GERMAN
Avail: NTIS

Pure single crystal surfaces with orientation of (100) for PbSe, (110) for HgSe, and (0001) for BiSe3 were investigated in the long wave emission range between 4 and 6.5 eV. Analysis of the spectral and energy distribution curves indicates the optical excitation mechanism and scattering of the emitted electrons. Each of the three materials displays a relationship between the quantum yield and the energy of the incident light. The optical work function and the electronegativity of the materials are plotted graphically.
Transl. by R.B.

N70-41453# National Science Foundation, Washington, D.C.
EFFECT OF ALKALINE EARTH METAL ADMIXTURES ON THE RATE OF ACCUMULATION OF COLOR CENTERS IN PROTON-IRRADIATED ALKALI HALIDE CRYSTALS [VLIYANIE SHCHELOCHNOZEMELNYKH PRIMESEI NA SKOROST NAKOPLENIYA TSENTROV OKRASKI V SHCHELOCHNO-GALOIDNYKH KRYSTALLAKH, OBLUCHENNYKH PROTONAMI]
V. M. Lisitsyn 1970 7 p Transl. into ENGLISH from Zh. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 5, no. 5, 1968 p 683–685
(TT-70-57067) Avail: NTIS CSCL 20B

The effect of Sr admixture on the kinetics of F and M centers accumulation in KCl and KBr crystals irradiated by protons has been investigated. It is shown that, in crystals containing admixtures, the rate of accumulation of F-centers increases in the 1 and 2 stages as compared with the pure ones. The rate of accumulation of M-centers increases in Sr-doped KCl-crystals in the initial period of irradiation and decreases when irradiated for a long period of time as compared with the pure KCl-crystals.
Author (USGRDR)

N70-41515*# Little (Arthur D.), Inc., Cambridge, Mass.
BASIC FACTORS CONTROLLING PEST IN HIGH TEMPERATURE SYSTEMS Progress Report
J. Berkowitz-Mattuck and M. Rossetti 24 Jul. 1970 14 p refs
(Contract NASw-1887)
(NASA-CR-113858; PR-2) Avail: NTIS CSCL 20L

To test the effect of various additives to molybdenum disilicide, strong pest resistant coatings were fabricated by cold pressing and sintering. Creep test show deformation at lower temperatures than for pure MoSi2. A similar phenomenon was observed in aluminide systems, particularly CbAl3. CbA13 crystals were fabricated by Czochralski growth from the melt and tested in air for delayed failure. Results indicate that the rate of pest failure is dependent on the applied stress level.
E.H.W.

N70-41520# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
CATION DISTRIBUTION IN ALUMINUM-SUBSTITUTED YTTRIUM IRON GARNETS BY MOESSBAUER EFFECT SPECTROSCOPY
Ernst R. Czerlinsky and Raymond A. Macmillan Apr. 1970 21 p refs /ts Phys. Sci. Res. Paper No. 417
(AD-709354; AFCRL-70-0215) Avail: NTIS CSCL 20/2

As part of a continuing search for magnetic materials with improved properties and broader applicability in microwave devices, recoil-free nuclear resonance absorption was determined on eleven different compositions of Y(3)Al(t)Fe(5-t)O(12) powder specimens with 0.39 = or < to = or < 4 above their Curie temperatures. The quadrupole splittings of the Fe57 nuclei in the garnet structure caused two absorption doublets for each composition. From the intensities of the lines, the distribution of Fe(3+) and Al(3+) on the tetrahedral and octahedral sites with regard to the composition was obtained. Some of the powders had been subjected to the identical and controlled heat treatment to establish their cation equilibrium at the same temperature. With both the cation distribution and the equilibrium temperature defined, the stabilization energy could be determined for each compound. This quantity is a measure for the site preference, in our particular case of Al(3+) in AlYIG materials. The results on the distribution are compared with earlier work on AlYIG, GaYIG and AlYGaG. The electric field gradients resulting from the position of the doublet lines are compared with other investigations on the same compounds.
Author (TAB)

N70-41558# National Science Foundation, Washington, D.C.
THEORY OF DIFFUSION IN SOLID BODIES: RELATION BETWEEN COEFFICIENT OF DIFFUSION IN SOLID BODIES AND CONCENTRATION [K TEORII DIFFUZII V TVERDYKH TELAKH: ZAVISIMOST KOEFFITSIENTA DIFFUZII V TVERDYKH TELAKH OT KONTSENTRATSII]
G. P. Ilkevich 1970 19 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 10, 1940 p 659–665
(TT-70-57024) Avail: NTIS

Statistical theory of mutual diffusion in solid solutions including the relation between diffusion coefficient and concentration has been suggested. The concept of diffusion as a process of change of places in lattice points has been taken as the basis. Diffusion coefficients of both the components have been obtained as a function of concentration and they follow the general law, i.e., the diffusion coefficient decreases with an increase in the concentration of diffusing component. The nature of diffusion coefficient qualitatively corresponds to the relation experimentally observed by Grube and Jedele (and calculated by Matano by Boltzmann's method) in the case of diffusion of nickel in copper.
Author (USGRDR)

N70-41611# Wayne State Univ., Detroit, Mich.
ELECTRON-HOLE RECOMBINATION LUMINESCENCE AT A VACANCY PAIR
Chaleo Manilerd (Ph.D. Thesis) 1970 59 p refs
(Contract AT(11-1)-1054)
(COO-1054-46) Avail: NTIS

Luminescence properties associated with imperfection defects in alkali halides are considered. Specifically, it employs the method of time-delayed luminescence to investigate the electron–hole recombination at the site of a vacancy pair (vacancy pair model). On the basis of the proposed model, the observed delayed luminescence spectra have been consistently interpreted. Furthermore, the activation energy for ionic diffusion, the ionization energy of an excited F center, and the ionization energy of an F center with an additional electron have been successfully evaluated.
Author (NSA)

N70-41619# Technische Univ., Berlin (West Germany). Fakultaet fuer Bergbau und Huettenwesen.
THE CRYSTAL STRUCTURE OF REINERITS, Zn3(ASO3)2 [DIE KRISTALLSTRUKTUR DES REINERITS Zn3(AsO3)2]
Kurt Weber (Ph.D. Thesis) 1968 91 p refs In GERMAN
Avail: NTIS

The crystal structure and chemical properties of a modified zinc arsenate compound are described. The compound has the chemical formula Zn3(AsO3)2 and has been named Reinerits.
Transl. by P.N.F.

N70-41622# Technische Univ., Berlin (West Germany). Fakultaet fuer Allgemeine Ingenieurwissenschaften.
CHEMICAL AND ELECTRICAL CRYSTALLOGRAPHIC STUDIES ON THE MIXED CRYSTAL SYSTEMS OF Li sub x Ti sub 1-x O AND LiTi sub 1-x Fe sub x O2 [KRISTALLCHEMISCHE UND ELEKTRISCHE UNTERSUCHUNGEN AN DEN MISCHKRISTALLSYSTEMEN Li sub x Ti sub 1-x O UND LiTi sub 1-x Fe sub x O2]
Rudolf Weber (Ph.D. Thesis) 1968 112 p refs In GERMAN
Avail: NTIS

X-ray analyses, electrical, and thermoelectrical methods are

employed to determine cation charge distributions in the systems Li sub x Ti sub 1-x O and LiTi sub 1-x Fe sub x O2. It is shown that deficiency-free mixed crystal series with NaCl structure exist and that statistical distributions of cations are indicated. Cation charge distributions confirm the lattice constant decrease with increasing x. Electrical conductances at higher x-values are explained by charge exchanges between Fe(2+) and Fe(3+) in the LiFeO2 system. Transl. by G.G.

N70-41643# American Univ., Cairo (Egypt). Dept. of Materials Engineering and Physical Sciences.
SOME SWITCHING CHARACTERISTICS OF CALCIUM BORATE GLASSES CONTAINING IRON Progress Report, 1 Feb. - 30 Apr. 1970
Adli Bishay, M. H. Omar, and M. El Hamamsy Jun. 1970 82 p refs
(Contract F61052-67-C-0050)
(AD-709707; AFOSR-70-2016TR; PR-13) Avail: NTIS CSCL 20/12

A series of calcium borate glasses containing from about 10 to 30 mole% Fe203 was investigated. Electrical switching phenomena were observed in all the samples. The threshold voltage decreased by a factor of about one hundred as the concentration of iron increased beyond 20 mole% Fe203. On the other hand, the threshold voltage increased with sample thickness and decreasing temperature for the same iron content. Negative resistance was sometimes observed before the samples were converted from the OFF to the ON state. A memory effect was also observed upon exceeding a certain threshold current. The switching phenomena (whether negative resistance or switching with memory effects) in the calcium borate glasses containing iron can be tentatively explained on the basis of a simple theory of Joule microheating. Author (TAB)

N70-41692# New Univ. of Ulster, Coleraine (Northern Ireland). School of Physical Sciences.
AN INVESTIGATION OF MATERIALS SUITABLE FOR THE FABRICATION OF SPACE CHARGE AMPLIFIERS Final Technical Report, 1 Oct. 1968 - 31 May 1970
R. H. Tredgold and W. D. Corlett Jun. 1970 20 p refs
(Contract DAJA37-69-C-0342)
(AD-709674; ARDG(E)-E-1230-3) Avail: NTIS CSCL 20/12

Two novel methods of Boron Phosphide thin film growth, using Boron Tribromide and Phosphorus trichloride are reported. One method employing the hydrogen reduction of the addition compound PCl3.BBr3, produces Boron Phosphide of varying purity. The other method, employing the hydrogen reduction of the individual compounds describes how Boron Phosphide (BP) and Boron Subphosphide (B13P2) can be formed. Various other methods tried for film and single crystal growth are described. The optical properties of Boron Phosphide from the ultraviolet to infrared is reported and rediimentary electrical measurements illustrated. Author (TAB)

N70-41694# Air Force Systems Command, Wright-Patterson AFB, Ohio. Avionics Lab.
STUDIES OF TRAPS IN A12O3 FILMS
Fritz L. Schuermeyer and Charles R. Young Jan. 1970 28 p refs Presented at the Conf. on Photoelec. and Secondary Electron Emission, Minneapolis, 26 - 27 Aug. 1969
(AD-709217; AFAL-TR-69-292) Avail: NTIS CSCL 20/12

Measurements of photocurrent as a function of photon energy were performed on thin film metal-insulator-metal samples at liquid-nitrogen temperature, at room temperature, and at 97C to determine the effect of temperature on the scattering parameters and barrier shapes. Evaporated aluminum films were electrochemically anodized, and aluminum or gold top electrodes were evaporated onto them. Patterns were then formed by photolithographic techniques. Chopped-light and phase-sensitive-detection techniques were used for the photomeasurements. Evaluation of the photomeasurements indicated that the main effect of temperature variation is a change in the barrier shape. The barrier height in the middle of the insulating film changes very drastically (approximately 0.5 EV larger at liquid-nitrogen temperature than at 97C), while the barrier heights at the interfaces change very little (approximately 0.1 EV). The change in barrier shape can be explained by an increased space charge due to trapping of electrons in the insulating thin film at low temperatures. It was found previously that the scattering of electrons within the insulating film can be measured most accurately if the electrons encounter a retarding field; that is, if the applied voltage is less than the difference of the two barrier heights. The present photomeasurements indicate that under such conditions, the slopes of the photoresponse, and hence the scattering of electrons within the insulator, are independent of the temperature. These findings agree with theory. Author (TAB)

N70-41729# IIT Research Inst., Chicago, Ill. Dept. of Physics.
INVESTIGATION OF ENERGY TRANSFER PROCESSES BY FLASH PHOTOLYSIS (RADIATION EFFECTS IN SOLIDS) Final Report
Leonard I. Grossweiner Jan. 1970 22 p refs
(Contract AT(11-1)-1052)
(COO-1052-12) Avail: NTIS

The research accomplished on this project falls into the areas: dye-sensitized photochemical oxidation of aqueous phenol; low temperature photoequilibria between F and F' centers; optical formation of F-aggregate centers and their spin-metastable states; effects of radiation on surface properties of alkali halide crystals; and mechanism of spectral sensitization of zinc oxide photoconductivity. A brief summary of each area is given. NSA

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N70-40500# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
A LOW TEMPERATURE DIFFERENTIAL THERMAL ANALYSIS OF HYDROXY-TERMINATED AND CARBOXY-TERMINATED POLYBUTADIENE Final Special Report
A. Tice, B. Bartizek, and D. M. Anderson Jun. 1970 13 p refs
(AD-708862; CRREL-SR-149) Avail: NTIS CSCL 7/4

A low-temperature differential thermal analysis of hydroxy- and carboxy-terminated polybutadiene was performed with varying amounts of n-butylferrocene. No distinct phase changes were observed to indicate that the sample components became separated during cooling. However, the slow transformation into the glassy state was observed, yielded glass transition temperatures of -80 to -95C. This is far below the low temperature specification for these propellants. This analysis yielded no evidence of a physical or chemical transition that might cause a low-temperature firing failure in the finished propellants. Author (TAB)

N70-41709# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
STUDY OF THE PARTICULATE MATTER IN THE EXHAUST OF A BORON-LOADED SOLID PROPELLANT
A. M. Mellor and F. C. Gouldin (Cornell Univ., Ithaca, N.Y.) 1 Aug. 1970 47 p refs
(Contract DAAH01-69-C-1109)
(AD-709878; RK-TR-70-11) Avail: NTIS CSCL 21/2

Particles issuing from the primary solid propellant combustor of a typical boron-loaded air-augmented rocket motor have been

collected and analyzed for chemical composition and size distribution. It was found that substantial changes can occur in the chemical composition of the particulate effluent (notably, ammonium pentaborate and carbon were found), but the size analyses suggest that no important change in the boron size distribution occurs. However, this last conclusion is subject to the uncertainties involved in any particle collection techniques influence on the size distribution results, and for this reason a discussion of possible in situ measurements using light scattering is included at the end of this report. Primarily because of the high optical depths involved in the primary motor plume, however, it is concluded that such experimental techniques would be unsuccessful. Author (TAB)

N70-41753# New York Univ., N.Y. Dept. of Chemical Engineering.
SOLID STATE REACTIONS IN SOLID PROPELLANTS Final Scientific Report, 1 Apr. 1968 – 31 Mar. 1969
Leonard Dauerman 1 Mar. 1970 27 p refs
(Grant AF-AFOSR-1491-68)
(AD-709731; AFOSR-70-2044TR) Avail: NTIS CSCL 21/9

The use of attenuated total reflectance spectroscopy in the study of solid propellants for the purposes of quality control and the elucidation of solid phase reactions is presented. In a separate study, the detection of CO2 using rapid-scanning optical spectroscopy during the pre-ignition phase of a solid propellant firing is reported and its value as a criterion for ignition discussed. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N70-40624*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A SWIRL-CAN PRIMARY COMBUSTOR TO OUTLET TEMPERATURES OF 3600 F (2256 K)
Richard W. Niedzwiecki, Albert J. Juhasz, and David M. Anderson Sep. 1970 10 p refs
(NASA-TM-X-52902) Avail: NTIS CSCL 21E

A swirl-can full-annulus combustor was operated at an average outlet temperature of 3616 F (2264 K) which is 377 R (187 K) below the stoichiometric temperature. The combustion efficiency, pattern factor, smoke emission, and pressure loss were all quite favorable. Author

N70-40659*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ANALYSIS OF THE CAPABILITIES AND LIMITATIONS OF TURBINE AIR COOLING METHODS
Jack B. Esgar, Raymond S. Colladay, and Albert Kaufman Washington Sep. 1970 51 p refs
(NASA-TN-D-5992; E-5669) Avail: NTIS CSCL 21E

The relative merits of convection, transpiration, and full coverage film air cooling methods were investigated for local turbine inlet temperatures from 2000 to 3500 F, gas pressures from 5 to 40 atmospheres, and cooling air temperatures from 600 to 1200 F. Effects of blade and vane wall thickness, leading edge radius, and material temperature were also investigated. The results indicate the design trends required for the cooled turbines of future engines, the superiority of transpiration and full coverage film cooling over convection cooling, and approaches that can be used to improve convection cooling. Author

N70-40758# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
AN INVESTIGATION OF ROTATING STALL PHENOMENA IN TURBINE ENGINE COMPRESSORS Final Report, Mar. 1967 – Mar. 1970
Gary R. Ludwig, Joseph P. Nenni, and Roy S. Rice, Jr. Wright-Patterson AFB, Ohio AFAPL May 1970 212 p refs
(Contract F33615-67-C-1552)
(AD-708484; CAL-DE-2422-S-12; AFAPL-TR-70-26) Avail: NTIS CSCL 21/5

The work encompasses both theoretical and experimental studies of rotating stall and an investigation of the requirements for a stall control system. The theoretical studies approached the problem primarily from the point of view that rotating stall is the consequence of an instability of the mean flow to small disturbances. Both two-dimensional flows and a certain class of three-dimensional flows with wheel-type swirl were studied. In addition, numerical experiments were performed with a computer program for a two-dimensional cascade of discrete flat plate blades. Of the theoretical models, only the two-dimensional small disturbance approach exhibited an instability which might lead to rotating stall. The experimental program was performed to provide fundamental data prior to and during rotating stall for comparison with theory and for use as a guide in improving the theoretical model. Extensive investigations of the conditions for inception and the properties of rotating stall were performed on a row of stator blades in an annular cascade. The effects of blade profile shape, blade stagger angle and blade row spacing were studied in the cascade. In addition, several methods for detecting unsteady pressures were studied to determine their suitability as a generator of a rotating stall signature which could be used in a closed loop control system. It was found that a pressure tap located on the suction surface of a stator blade near the quarter-chord showed promise of providing a satisfactory signal. Author (TAB)

N70-40996*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DESIGN, FABRICATION, AND TESTING OF THE APPLICATIONS TECHNOLOGY SATELLITE APOGEE MOTOR INSULATION
Richard A. Grippi, Jr. 15 Sep. 1970 49 p refs
(Contract NAS7-100)
(NASA-CR-113820; JPL-TM-33-341) Avail: NTIS CSCL 21H

The design, development, formal qualification, and flight phases of the Applications Technology Satellite (ATS) solid propellant apogee motor program are reported. The design concept, type of material, fabrication, and performance of the titanium motor chamber insulation system are described in detail. The motor is insulated with Gen-Gard V-52, which is a material formulated of polybutadiene-acrylonitrile rubber, hydrated silica, asbestos fiber, reinforcing resin, plasticizer, antioxidant, and processing and vulcanizing agents. To develop and confirm the insulation design, numerous motor chambers were instrumented with thermocouples on the external surface to obtain temperature data during and after motor firing. The temperature results of these tests are presented for units instrumented in the motor development and qualification phase. Author

N70-41058*# Rocketdyne, Canoga Park, Calif. Advanced Turbomachinery.
LOW SPEED INDUCERS FOR A ROCKET ENGINE FEED SYSTEM Final Report
J. A. King Jun. 1970 111 p refs
(Contract NAS3-10280)
(NASA-CR-72716; R-8272) Avail: NTIS CSCL 21E

Analytical performance data for optimum lowspeed inducers were developed, and analog and digital system simulation were used to evaluate the potential of using a low-speed inducer to simplify propellent tank pressurization and avoid resonant interaction of oscillations in the feed system and vehicle structure. Transient study results defined low-speed fuel inducer requirements for starting with zero suction pressure. Results of a study of LOX feed

system oscillations indicate a low-speed inducer can significantly alter feed system-engine structure frequency response characteristics. Author

N70-41100*# Rocketdyne, Canoga Park, Calif.
NONCIRCULAR ORIFICE HOLES AND ADVANCED FABRICATION TECHNIQUES FOR LIQUID ROCKET INJECTORS. PHASE 1: ANALYTICAL AND EXPERIMENTAL STUDY OF NONCIRCULAR INJECTOR ORIFICES, AND ELEMENTS FOR LIQUID/LIQUID INJECTORS Final Report
W. H. Nurick and R. M. McHale 15 Sep. 1970 252 p refs
(Contract NAS9-9528)
(NASA-CR-108570; R-8224) Avail: NTIS CSCL 21H

The program phase reported consists of an analytical study of various injector patterns and elements that utilize noncircular orifices, along with experimental evaluations of promising element configurations. Cold flow characterization and theoretical combustion modeling combined with single element hot firing experiments are employed to predict the relative merits of liquid rocket engine injector elements incorporating orifices of noncircular shape as compared to circular shapes. The frozen wax technique is used to determine dropsize; water/trichlorethylene spray collection through a tube matrix is used to determine mixing efficiency. Unlike-doublet elements incorporating circular, triangular, rectangular, and self-atomizing orifices are compared on the basis of overall characteristic velocity efficiency. Results indicate that at optimum design conditions for equal thrust per element designs, mixing levels are higher for noncircular shapes while circular orifices produce smaller dropsizes. Author

N70-41275* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ZERO GRAVITY STARTING MEANS FOR LIQUID PROPELLANT MOTORS Patent
Richard N. Porter, inventor (to NASA) Issued 31 Jan. 1967 (Filed 7 Jan. 1965)
(NASA-Case-XNP-01390; US-Patent-3,300,981;
US-Patent-Appl-SN-424157) Avail: US Patent Office CSCL 21H

A method is described for containing a small auxiliary body of liquid propellant within a collapsible container located in the propellant tank such that the auxiliary body of liquid propellant is subjected to the force exerted by the propellant pressurizing gas. A means is provided to utilize the auxiliary body of propellant during the initial period of rocket motor operation in order to reestablish a gravity or inertial force field. As the auxiliary body of propellant is depleted, the main body of the propellant becomes available to provide uninterrupted operation of the rocket motor. The collapsible container is refilled during operation of the rocket motor, providing a restart capability after the engine has been cut off under zero gravity conditions. R.B.

N70-41311* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
IGNITION MEANS FOR MONOPROPELLANT Patent
Donald H. Lee and David D. Evans, inventors (to NASA) Issued 17 Jan. 1967 (Filed 24 Jun. 1964) 5 p Cl. 60-251 Sponsored by NASA
(NASA-Case-XNP-00876; US-Patent-3,298,182;
US-Patent-Appl-SN-377784) Avail: US Patent Office CSCL 21H

A catalyst bed system for igniting hydrazine for Ranger spacecraft midcourse correction is described. The bed consists of a thin layer of catalyst pellets coated with an oxidizer in solid form. When hydrazine is introduced it undergoes a vigorous oxidation-reduction reaction upon contact with the coating, releasing sufficient heat to decompose the hydrazine. The suggested pellet composition is aluminum oxide, and the preferred coating is a mixture of one mole each of nickel, cobalt, and ferric nitrates. N.E.N.

N70-41447* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH PRESSURE FILTER Patent
William F. MacGlashan, Jr., inventor (to NASA) Issued 3 Jan. 1967 (Filed 28 Feb. 1963) 4 p Cl. 210-314 Sponsored by NASA
(NASA-Case-XNP-00732; US-Patent-3,295,684;
US-Patent-Appl-SN-261918) Avail: US Patent Office CSCL 21H

A compact filter for rocket fuel lines subjected to pressures in the range of 12,000 lbs/sq in. are described. The filter is provided with an initial and a final filter disk both peripherally sealed with respect to the surrounding wall of the filter housing by an O-ring. The filter assembly may be readily installed, removed, and replaced. N.E.N.

N70-41470*# Aerojet Solid Propulsion Co., Sacramento, Calif. Advanced Technology.
STUDY OF STORAGE AND HANDLING OF THE 260 INCH DIAMETER SOLID ROCKET MOTOR, VOLUME 1 Final Report
H. K. Whitfield Sep. 1970 223 p
(Contract NAS3-12052)
(NASA-CR-72757-Vol-1) Avail: NTIS CSCL 21H

Evaluations were made of the methods of handling the 260-in. diameter solid-rocket motor stage between the Aerojet/Dade County Plant and the NASA-KSC Launch Complex 37, Pad B. Also, handling methods were investigated for alternative destinations and motor design including: (1) the NASA-KSC Saturn V crawler/transporter, (2) the U.S. Air Force Western Test Range, and (3) the 260-in. diameter segmented motor configuration. Initially, three separate handling methods were identified and evaluated. The optimum handling method selected from the three methods was further defined and refined. Detailed static and dynamic stress analyses were accomplished to support the handling-method evaluation and to determine the effect of critical handling and storage loads on the stage. The results show that the 260-in. diameter solid-rocket motor stage can be reliably and economically handled, transported, stores, and erected using tooling, equipment, and facilities that are within the existing state-of-the-art. Author

N70-41471*# Aerojet Solid Propulsion Co., Sacramento, Calif.
STUDY OF STORAGE AND HANDLING OF THE 260 INCH DIAMETER SOLID ROCKET MOTOR, VOLUME 2 Final Report
H. K. Whitfield Sep. 1970 185 p refs
(Contract NAS3-12052)
(NASA-CR-72757 Vol-2) Avail: NTIS CSCL 21H

The results are presented of a program to evaluate the methods of handling the 260 in. diameter solid rocket motor stage between the Aerojet/Dade County Plant and the NASA-KSC launch complex. A sequence of operations for three handling methods is given in addition to results of the following studies: (1) Stress analyses were conducted to evaluate the three proposed handling and storage methods and the critical load conditions were established. (2) A comparative assessment of the major elements of the three methods was made and an engineering trade-study conducted to select the optimum handling method. (3) The proposed storage facility location and its relationship to the launch complex was reviewed and potential overland routes were evaluated. (4) A dynamic analysis study was made to evaluate the proposed barge transportation methods, with respect to structural dynamic considerations, and to recommend a method that would result in successful towed barge shipments. D.L.G.

N70-41576* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPARATUS FOR INCREASING ION ENGINE BEAM DENSITY Patent
Lionel V. Baldwin and Virgil A. Sandborn, inventors (to NASA) Issued 22 Nov. 1966 (Filed 4 Jan. 1963) 5 p Cl. 313-63
(NASA-Case-XLE-00519; US-Patent-3,287,582;
US-Patent-Appl-SN-249542) Avail: US Patent Office CSCL 21C

The described mechanism utilizes an ion beam generating

apparatus of the type having an ion emitter and a separated ion accelerator. An electrical potential gradient is established between the emitter and the accelerator so that ions flow from the emitter towards the accelerator to form an ion beam. An electron source mounted between the ion emitter and the accelerator increases the density of the ion beam. The fast-moving electrons from the source travel within the ion beam in a direction opposite to that of the ion movement, increasing the beam density and thus increasing the available power per unit area. R.B.

N70-41582* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVICE FOR SUPPRESSING SOUND AND HEAT PRODUCED BY HIGH-VELOCITY EXHAUST JETS Patent
Fritz Kramer, inventor (to NASA) Issued 6 Sep. 1966 (Filed 16 Jun. 1964) 9 p Cl. 181-52
(NASA-Case-XMF-01813; US-Patent-3,270,835; US-Patent-Appl-SN-375674) Avail: US Patent Office CSCL 21H

A device is described which adds a mass of water to the exhaust jet to decrease the velocity and temperature of the jet. The exhaust jet is directed into an enclosure which contains a water reservoir and a platform supporting a Venturi-shaped diffuse. The enclosure, diffuser, and platform are so designed that as the jet passes through the diffuser it creates a powerful suction drawing the water into the diffuser. The water reduces the velocity, and therefore the noise, and the temperature of the jet. Water is reclaimed from the mixture of cooled exhaust gases, steam, and water droplets, and is circulated for reuse. N.E.N.

N70-41750# Inter-Controls, Inc., Washington, D.C.
ENGINE CONTROL SYSTEMS STUDY AS APPLIED TO INTER-ENGINE THRUST CONTROL
Andrew N. Parras and Paul W. Hughett Jan. 1970 247 p refs
(Contract N00019-68-C-0117)
(AD-709411) Avail: NTIS CSCL 21/5

VTOL type aircraft incorporating turbo-fan engines as lifting means do not sensibly lend themselves to the cross-coupling provisions inherently available with the shafting of propeller type engines. An engine failure in the fan engine case is therefore a considerably more precarious matter for which provision for thrust compensation more responsive than a pilot would appear to be required. The study utilizes a very comprehensive hybrid simulation of the WTF-60 engine wherein all engine components are simulated on a performance map basis thereby including all non-linearities as well as permitting the availability of any and all engine parameters for use as controlled variables operating in conjunction with the manipulated variable, fuel flow. Further, realistic acceleration control in the course of large upsets is accomplished thereby permitting a control system analysis which is completely applicable to the detail design of the control system and the selection of components. Author (TAB)

N70-41754*# United Technology Center, Sunnyvale, Calif.
DEMONSTRATION OF A STERILIZABLE SOLID PROPELLANT ROCKET MOTOR Final Report, Feb. 1969–Jul. 1970
L. Weinberg Jul. 1970 181 p
(Contract NAS1-8937)
(NASA-CR-111772) Avail: NTIS CSCL 21H

The results are summarized of laboratory, subscale, and full-scale tests demonstrating the ability of a flightweight rocket motor for unmanned planetary landers to withstand six dry heat sterilization cycles which maintain the most thermally remote point in the motor at a temperature of 275 F for 53 hr. Particular attention was given the transition from laboratory tests to prototype tests. Although the CTPIB-based propellant had remarkable thermal stability and physical properties during and after sterilization cycling and although the liner and insulation displayed more than adequate physical properties as individual components, the flightweight motors suffered propellant separation at or adjacent to the propellant/liner interface. It became apparent that the tensile and/or shear stress imposed on the system during heatup exceeded the allowable strength. The ability of a solid propellant rocket motor (loaded with propellant UTP-11439) to successfully survive dry heat sterilization depends upon the high temperature strength of the bond between propellant and liner as well as the structural adequacy of the propellant Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N70-40584# Analysis and Computer Systems, Inc., Burlington, Mass.
SPACE FORECASTING DEVELOPMENT AND DATA PROCESSING Final Report, 15 Nov. 1967–14 Nov. 1969
John R. Cunningham, James R. Delaney, John A. Fusco, Elaine J. Shea, and Norman E. Williams Apr. 1970 66 p refs
(Contract F19628-68-C-0077)
(AD-708738; AFCRL-70-0253) Avail: NTIS CSCL 4/1

The Space Forecasting Development and Data Processing project is a Research and Development (R and D) effort under development at Air Force Cambridge Research Laboratories (AFCRL) in conjunction with the Air Weather Service (AWS). This R and D project is an effort to develop a series of mathematical models capable of processing astrogeophysical data in order to enhance the operational capability of the Solar Forecast Center (SFC). The computer programs developed are to be part of a larger system to be executed on a series of Univac 1108 digital computers at Offutt Air Force Base, Omaha, Nebraska. The developed programs will process and analyze incoming data for specific scientific disciplines closely related to pertinent solar phenomena and the effect caused on the atmosphere due to such solar activity. Author (TAB)

N70-40618# Air Force Cambridge Research Labs., Bedford, Mass. Research Library.
FORMULAS AND GRAPHS FOR A QUANTITATIVE ANALYSIS OF THE FORBIDDEN RADIATION LINES IN EMISSION OBJECTS
A. A. Boyarchuk et al Apr. 1970 25 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Krymsk. Astrofiz. Observ. (Moscow), no. 69, 1969 p 279–294
(AD-708513; AFCRL-70-0271; Trans-77) Avail: NTIS CSCL 4/1

Working formulas and graphs necessary for a quantitative analysis of the forbidden lines of emission objects are given. The results of Boyarchuk, et al., (1963) are made more precise, and convenient graphs are given for a fast determination of the physical conditions in a radiating medium, according to Seatons intersection of curves method. A general scheme is given for computer calculations of the ratios between line intensities and their absolute luminosity, with a consideration for the dependence of these values on the electron temperature, electron density, temperature of ionizing radiation and dilution factor. Author (TAB)

N70-40889*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR CYCLE PREDICTION TECHNIQUE
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 9 p refs (See N70-40878 23-30)
Avail: NTIS CSCL 03B

A mathematical description, in terms of input and output, is provided for the method used to predict future levels of solar activity. The obtaining of the Zurich smooth sunspot numbers,

which are used as input data, the computational procedure, and the computer output are described. The sunspot numbers may be predicted for 15 years in advance and may be evaluated at quarterly, monthly, or 27-day intervals. An example of solar activity prediction is provided. P.A.B.

N70-40925# Ohio State Univ. Research Foundation, Columbus.
SPACE WEATHER FORECASTING Final Report, 1 Oct. 1966 - 30 Sep. 1969
H. C. Ko Jun. 1970 41 p refs
(Contract AF 19(628)-6145)
(AD-709227; AFCRL-70-0378) Avail: NTIS CSCL 4/1

The present state of space weather forecasting, its applications and forecast requirements are discussed. Physical basis of space weather forecasting is reviewed with special emphasis on the sudden ionospheric disturbances, solar proton events and geomagnetic storms. Precursors and indicators for the occurrence of these events its duration and severity are discussed. New areas of investigation are recommended. Author (TAB)

N70-40998*# California Univ., San Diego. Dept. of Physics.
LONG TERM VARIATIONS IN HIGH-ENERGY GEOMAGNETICALLY TRAPPED PARTICLES
Sherman Edward De Forest (Ph.D. Thesis) Jul. 1970 64 p refs
(Grant NGL-05-005-007)
(NASA-CR-113812; UCSD-SP-70-2) Avail: NTIS CSCL 04A

The omnidirectional flux of geomagnetically trapped protons of 40-110 MeV has been measured by identical detectors on board three spacecraft (Injun 3, Explorer 15, and Explorer 26) from 1963 to 1966. These data are shown to be consistent with a model of protons diffusing by violation of the third adiabatic invariant. Author

N70-41190# Office of Research Analyses, Holloman AFB, N.Mex.
A MODEL FOR EVALUATING THE UTILITY OF FORECASTING NATURAL ENVIRONMENTAL PHENOMENA Final Report
Richard H. Anderson and Hans J. Richter Apr. 1970 27 p
(AD-709190; ORA-70-0002) Avail: NTIS CSCL 4/1

A probabilistic model is developed which quantitatively allows one to assess the potential utility of procedures for forecasting phenomena which threaten the success of a mission. It is applied to the particular situation where certain physical phenomena associated with solar activity threaten the success of aerospace missions. The influences of basic parameters of the mission, threat, and forecast are demonstrated. Author (TAB)

N70-41323# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. Radiation Analysis and Shielding Section.
STATISTICAL ANALYSIS OF SOLAR COSMIC RAY PROTON DOSE
W. R. Yucker Jun. 1970 67 p refs
(MDC-G-0363) Avail: NTIS

The results of a statistical analysis of the radiation hazard to astronauts due to solar cosmic ray protons are described. More recent data are incorporated into the present analysis, including events from 1956 to 1969, in order to improve the accuracy of the predicted mission fluence and dose. An attempt is made to present a consistent and unified view of the solar cosmic ray proton hazard and to justify the application of a stastical approach for mission planning purposes. Mission fluence and dose versus shield thickness data are presented for mission lengths up to 3 years during periods of maximum and minimum solar activity, and corresponding to various levels of confidence that the predicted hazard will not be exceeded. Author

N70-41549# Aerospace Corp., El Segundo, Calif. Lab. Operations.
PROTON ENERGY DISTRIBUTIONS FROM 0.060 TO 3.3 MeV AT 6.6 EARTH RADII
John R. Stevens, E. Frank Martina, and R. Stephen White (Calif. Univ.) 15 Jul. 1970 38 p refs
(Contract F04701-70-C-0059)
(AD-709723; TR-0059(6260-20)-4; SAMSO-TR-70-262) Avail: NTIS CSCL 4/1

Proton differential fluxes are reported for 12 energies from 0.060 to 3.3 MeV at 6.6 earth radii for the time period of October 2 to 13, 1968. The proton energies were measured with a surface barrier semi-conductor detector and a stacked discriminator pulse height analyzer on the Air Force Office of Aerospace Research Satellite OV2-5 (1968-81A). The typical quiet time fluxes decreased by 8 orders of magnitude over the measured energy interval. During this time the energy spectrum varied from (E sup (-3.5) to E sup (-6.0)). Below 200 keV the energy distributions flatten but never peak above the energy of the lowest channel, 68 keV. Energy spectra associated with the two magnetic storms on October 2 and October 12 are presented. After the storms the fluxes were higher than before. This is particularly true at the lower energies measured. Quiet time pitch angle distributions near the local noon-midnight meridian clearly show the east-west effect caused by the radial gradient in the fluxes. The pitch angle distributions at local midnight show the drift loss cone predicted by Roederer. Author (TAB)

N70-41562# Aerospace Corp., El Segundo, Calif. Lab. Operations.
CHARGE-EXCHANGE CROSS SECTIONS FOR HYDROGEN AND HELIUM IONS INCIDENT ON ATOMIC HYDROGEN: 1 TO 1000 keV
E. Scott Claflin 1 Jul. 1970 29 p refs
(Contract F04701-70-C-0059)
(AD-709722; TR-0059(6260-20)-1; SAMSO-TR-70-258) Avail: NTIS CSCL 7/4

A literature search was made for values of the charge-exchange cross sections of H(+), He(++), and He(+) incident on atomic hydrogen in the energy range 1 to 1000 keV. Best estimates of the cross sections were derived from the accumulated data. Results are presented in a series of tables and graphs and are accompanied by a discussion of accuracy and consistency. Author (TAB)

N70-41660# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ADIABATIC PRESERVATION OF GYROPHASE COHERENCE IN THE EARTH'S FIELD, AUGUST 1969 - JANUARY 1970
John M. Cornwall and Michael Schulz 30 Jul. 1970 16 p refs
(Contract F04701-70-C-0059)
(AD-709721; TR-0059(6260-20)-3; SAMSO-TR-70-245) Avail: NTIS CSCL 4/1

In the limit of adiabatic motion the number of gyrations per bounce is so constant that the gyrophase (mod 2pi) at which a particle crosses the equator advances by the same angular increment from each bounce to the next under azimuthal symmetry. Two particles having the same three adiabatic invariants recover their initial gyrophase relationship after each bounce period. Gyrophase organization of particles having the same three invariants is therefore able to survive several bounce periods of adiabatic motion, a result which may be important for triggered-emission and echo processes involving electron cyclotron waves. Author (TAB)

N70-41727# Air Force Cambridge Research Labs., Bedford, Mass.
QUIESCENT AND DISTURBED PROTON AND ELECTRON DISTRIBUTIONS
Virgil H. Webb, Paul L. Rothwell, and Ludwig Katz Jun. 1970 20 p refs *Its* Ser. No. AFCRL-ERP-324
(AD-709363; AFCRL-70-0334) Avail: NTIS CSCL 4/1

Ionizing radiation within the Earths magnetosphere presents a potential hazard to men as well as to sensitive equipment operating in this region. Thus, investigation of the detailed structure, as well as the variability of this radiation, is an important aspect of the continuing studies of the environment within which the Air

Force operates. Air Force satellite OV1-13, instrumented to measure the differential energy spectra of protons and electrons, was launched on April 6, 1968 into a polar orbit with an apogee and perigee of 9300 km and 570 km, respectively. Both proton and electron data for energies between 0.1 and 1.0 MeV, obtained during the June 9, 1968 magnetic storm, are presented in the form of flux distributions and Eo versus L plots with emphasis being placed on the late-morning sector of the outer belt. Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N70-40511 Indiana Univ., Indianapolis.
THE FORMATION AND GROWTH OF CARBON PARTICLES IN COOL STELLAR ATMOSPHERES
John Dekle Fix (Ph.D. Thesis) 1969 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-17751

A system of differential equations is developed to describe the nucleation, growth, and evaporation of carbon particles in masses of gas undergoing changes in temperature and pressure. Results are given for calculations performed to determine how the initial temperature, amplitude of temperature variation, composition and initial pressure of the mass of gas, period of the temperature and pressure cycle, and particle shape influence the number and sizes of particles produced during a cycle. It is concluded that carbon particles could form and grow under a wide range of conditions in the atmospheres of carbon stars and perhaps under very benevolent conditions in the atmospheres of M stars. It is argued that the presence of solid particles could account for some of the phenomena observed in cool, variable stars. Among these phenomena are infrared emission, veiling of spectral features near minimum light, and intrinsic polarization of the light of cool stars. Dissert. Abstr.

N70-40544 California Univ., San Diego.
THE NORMAL MODES OF A ROTATING ELLIPTICAL EARTH
Francis Anthony Dahlen, Jr. (Ph.D. Thesis) 1969 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-19357

Rayleigh's principle is used to provide a formalism which allows the approximate computation of the normal mode eigenfrequencies of any Earth model which is slowly rotating and slightly aspherical and anisotropic. This formalism is used to compute, correct to second order, the effects of the Earth's angular rotation, and correct to first order, the effects of the Earth's ellipticity of figure on the normal mode eigenfrequencies. It is found that for most of the poloidal or toroidal multiplets, the central (m = 0) member of the multiplet is shifted slightly in frequency and that the other members of the multiplet are split apart asymmetrically by the effects of the Earth's rotation and ellipticity. The results may be used to make a preliminary correction for rotation and ellipticity to the Earth's raw normal mode data. Dissert Abstr.

N70-40823# Virginia Univ., Charlottesville.
MODEL ATMOSPHERES FOR DEGENERATE STARS Final Report
Shiv S. Kumar 1970 5 p refs
(Contract N00014-69-A-0060-0001)
(AD-708452) Avail: NTIS CSCL 3/2

A general program for the computation of model atmospheres for degenerate stars was written in Algol for the B5500 computer at the University of Virginia. The program has been used to study the atmospheric structure of (lambda) 4670 stars and DG stars. New model atmospheres were obtained for these stars and the comparison of these models with the observed data (spectra, colors, etc.) is in progress. TAB

N70-40833*# Geological Survey, Washington, D.C.
PARAPHRASED GEOLOGICAL EXCERPTS FROM APOLLO 12 MISSION
David Schleicher, ed. Jun. 1970 129 p
(NASA Order T-65253-G)
(NASA-CR-113797) Avail: NTIS CSCL 22A

A transcript is presented of all data of potential geologic significance transmitted by the astronauts and capcom during the Apollo 12 mission. It includes descriptions made during descent to the moon, before and during each EVA, and during the trans-earth coast. The geologic data have been edited and paraphrased to condense the transcript and resolve some of the ambiguities that arise from literal transcription of extemporaneous oral descriptions. Author

N70-40876*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE ENVIRONMENT CRITERIA GUIDELINES FOR USE IN SPACE VEHICLE DEVELOPMENT
Don K. Weidner, ed. 26 Aug. 1970 207 p refs Revised
Supersedes N70-22208
(NASA-TM-X-53957) Avail: NTIS CSCL 03B

CONTENTS:

1. INTERPLANETARY SPACE ENVIRONMENT 20 p refs (See N70-40877 23-30)
2. TERRESTRIAL SPACE 31 p refs (See N70-40878 23-13)
3. CISLUNAR SPACE 5 p ref (See N70-40879 23-30)
4. THE MOON 57 p refs (See N70-40880 23-30)
5. MERCURY 12 p refs (See N70-40881 23-30)
6. VENUS 15 p refs (See N70-40882 23-30)
7. MARS 28 p refs (See N70-40883 23-30)
8. JUPITER 8 p refs (See N70-40884 23-30)
9. SATURN 5 p refs (See N70-40885 23-30)
10. URANUS 3 p refs (See N70-40886 23-30)
11. NEPTUNE 3 p refs (See N70-40887 23-30)
12. PLUTO 2 p refs (See N70-40888 23-30)
13. SOLAR CYCLE PREDICTION TECHNIQUE 9 p refs (See N70-40889 23-29)
14. COMPUTATIONAL PROCEDURE USED IN THE DEVELOPMENT OF THE MSFC MODIFIED JACCHIA MODEL ATMOSPHERE (1967) 11 p refs (See N70-40890 23-13)
15. A PRELIMINARY SUMMARY OF THE MSFC PLANETARY ATMOSPHERE COMPUTER PROGRAM 9 p (See N70-40891 23-13)

N70-40877*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INTERPLANETARY SPACE ENVIRONMENT
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 20 p refs (See N70-40876 23-30)
Avail: NTIS CSCL 03B

With interplanetary space defined as the region from the sun to the outer limits of the solar system, exclusive of those spheres under the influence of the individual planetary systems, data are provided in the following areas: gas properties; radiation environment, including galactic cosmic radiation, solar cosmic radiation, solar radiation properties, and solar radio noise; meteoroids, asteroids, and comets; geomagnetic environment; and astrodynamic constants. P.A.B.

N70-40879*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CISLUNAR SPACE
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 5 p ref (See N70-40876 23-30)
Avail: NTIS CSCL 03B

Cislunar space encompasses the region between the earth and moon that extends from 65,000 to 344,400 km; the outer limit of this region is stated to be 40,000 km inside the mean lunar orbital distance and is considered to be the outer limit, from the moon, of the moon's sphere of influence. The meteroid environment model, composed of sporadic meteoroids in the mass range between 1 gram and 10 to the minus 12th power grams and stream meteoroids in the mass range from 1 gram to the minus sixth power grams is discussed. Data are provided for the average sporadic meteoroid environment, including the flux-mass model. P.A.B.

N70-40880*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE MOON
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 57 p refs (See N70-40876 23-30)
Avail: NTIS CSCL 03B

Based upon data generated prior to the Apollo 11 flight and also upon data generated in a preliminary analysis of the Apollo 11 lunar samples, information is presented concerning the moon's atmospheric and surface environments. Discussion of the atmospheric environment includes gas properties; radiation, meteoroid, and geomagnetic environments; and astrodynamic constants. Surface environment information encompasses optical properties, thermal and electrical properties, an engineering lunar surface model for mobility considerations, terrain properties, lunar craters, and lunar blocks. Tables and graphs illustrate the data. P.A.B.

N70-40881*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MERCURY
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 12 p refs (See N70-40876 23-30)
Avail: NTIS CSCL 03B

The atmospheric environment of Mercury is considered to be the region of space between the planetary surface and 20,000 km above the surface; data are presented concerning gas properties, ionosphere, clouds, circulation, radiation, meteoroid environment, geomagnetic environment, and astrodynamic constants. Six model atmospheres, generated from empirical temperature profiles and pressure, temperature, and composition data, are described in tabular form. Surface environment information is also provided. P.A.B.

N70-40882*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
VENUS
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 15 p refs (See N70-40876 23-30)
Avail: NTIS CSCL 03B

Data concerning the atmospheric environment of Venus are presented in the areas of gas properties, ionosphere, clouds, circulation, radiation environment, meteoroid environment, geomagnetic environment, and astrodynamic constants. The computed quantities of four model atmospheres, generated from given temperature and molecular weight profiles and surface pressure information, are tabulated. Surface temperature, features, terrain and composition, and dielectric constant are also discussed. P.A.B.

N70-40883*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MARS
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 28 p refs (See N70-40876 23-30)
Avail: NTIS CSCL 03B

The atmospheric environment and surface environment of the planet Mars are delineated. Atmospheric data include gas properties; ionosphere; clouds; winds; radiation, meteoroid, and geomagnetic environments; and astrodynamic constants. Computed quantities of three model atmospheres are tabulated. Surface environment information encompasses mechanical properties, electrical properties, optical thickness, spectral albedo, photometric function, and temperature. Satellite data are also summarized. P.A.B.

N70-40884*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
JUPITER
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 8 p refs (See N70-40876 23-30)
Avail: NTIS CSCL 03B

Jovian atmospheric environment information is presented with regard to gas properties, ionosphere, clouds, winds, radiation, meteoroids, geomagnetic environment, and astrodynamic constants. A model for the composition of the planet is discussed. Satellite data are summarized in tabular form. P.A.B.

N70-40885*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 5 p refs (See N70-40876 23-30)
Avail: NTIS CSCL 03B

The planet Saturn is described with reference to the composition of its atmosphere, radiation, astrodynamic constants, telescopic appearance, and rings. Satellite data are summarized in tabular form. P.A.B.

N70-40886*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
URANUS
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 3 p refs (See N70-40876 23-30)
Avail: NTIS CSCL 03B

The telescopic appearance and atmosphere of Uranus are briefly described, and the astrodynamic constants are given. Tabular data for the five satellites are provided. P.A.B.

N70-40887*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NEPTUNE
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 3 p refs (See N70-40876 23-30)
Avail: NTIS CSCL 03B

Neptune is described with reference to its telescopic appearance, its atmosphere, and its astrodynamic constants. Satellite data are tabulated. P.A.B.

N70-40888*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PLUTO
In its Space Environment Criteria Guidelines for Use in Space Vehicle Develop. 26 Aug. 1970 2 p refs (See N70-40876

23-30)
Avail: NTIS CSCL 03B

A general description of Pluto and its discovery is provided, along with astrodynamic constants data. P.A.B.

N70-40902*# Geological Survey, Washington, D.C.
ESTIMATES OF THE MECHANICAL PROPERTIES OF LUNAR SURFACE USING TRACKS AND SECONDARY IMPACT CRATERS PRODUCED BY BLOCKS AND BOULDERS
H. J. Moore July 1970 69 p refs
(NASA Order R-66)
(NASA-CR-113807) Avail: NTIS CSCL 03B

Static analyses of 48 lunar blocks and boulders and their tracks yield friction angles between 10 and 30 deg and averaging about 17 degrees. For 115 secondary impact craters and their corresponding blocks, dynamic strengths are estimated. Velocities of the blocks are calculated using a ballistics equation and assuming an ejection angle of 45 degrees. Comparisons between dynamic strengths and expected static strengths show that most of the dynamic strengths correspond to the static strengths when the friction angle is 30 degrees and larger. Data on experimental low velocity impacts with natural targets are compared with the lunar data on secondary impacts. Nara's modified Poncelet equation for sand yields an average angle of internal friction near 34 degrees using the appropriate block and soil constants. Author

N70-40918# Environmental Science Services Administration, Boulder, Colo. Earth Sciences Labs.
ON THE SOLAR DYNAMO THEORY
Keith Leon McDonald Jul. 1970 28 p refs
(ESSA-TR-ERL-173-ESL-8) Avail: SOD $0.25

A rough description of the basic mechanisms involved in the solar dynamo theory is presented, together with a description of the large-scale or secular velocity fields and the principal magnetic fields. A rather detailed description of the principal magnetic and velocity fields is given with a further discussion of meridional circulations. The formalism relevant to a spherical harmonic analysis of the velocity field over the photospheric surface is presented and the observational difficulties involved in ascertaining the poloidal and scaloidal radial functions from which the meridional motions are synthesized are shown. The mean turbulent differential rotation is analyzed into toroidal vectors of odd degree in a straightforward manner. The effects upon the earth's magnetic field of the presence or absence at the upper level of the circulating toroids are cited. The region above the upper toroidal field is potentially a zone of convective instability. Author

N70-40924# Stanford Univ., Calif. Inst. for Plasma Research.
LEMAITRE MODELS AND THE COSMOLOGICAL CONSTANT
Vahe Petrosian and E. E. Salpeter (Cornell Univ., Ithaca, N.Y.) Jun. 1970 17 p refs
(Contract N00014-67-A-0112-0006)
(AD-709149; SU-IPR-371) Avail: NTIS CSCL 3/2

The discovery of quasistellar objects with large redshifts has renewed interest in the cosmological constant and in the Lemaitre type cosmological models. Recent views are reviewed in this document. TAB

N70-40948# Chicago Univ., Ill. Dept. of Astronomy and Astrophysics.
INVESTIGATIONS IN STELLAR DYNAMICS Final Report, 1 Oct. 1966 – 31 Mar. 1970
Peter O. Vandervoort 1 Aug. 1970 11 p refs
(Contract N00014-67-E-0260)
(AD-709654) Avail: NTIS CSCL 3/1

The report concerns aspects of the equilibrium and dynamics of self-gravitating stellar systems. Considerable progress has been made in constructing equilibrium configurations of highly flattened, rapidly rotating galaxies. A formal third integral of the motion has been constructed for the orbit of a star in a nearly spherical stellar system. A preliminary version of a theory of non-linear density waves in galaxies has been formulated. An investigation of moving pairs among the A-type stars in the solar neighborhood has been performed. Author (TAB)

N70-41011 Royal Observatory, Edinburgh (Scotland). Science Research Council.
SPECTROPHOTOMETRY OF COOL STARS IN THE NEAR INFRARED. 1: RESULTS FOR A REGION IN CYGNUS
K. Nandy and F. Smriglio (Observatorio Astron. di Roma) 1970 26 p refs *Its* Publ., Vol. 7, No. 1
Copyright. Avail: Issuing Activity

The distribution of relatively cool stars was investigated from objective prism spectra in the near infrared in a region of about 12 square degrees in Cygnus. Spectral types and apparent infrared magnitudes of 442 M and C stars were obtained. The limiting infrared magnitude is 12m0. The classification is based on the relative strengths of the molecular bands in the infrared. Estimates of the interstellar extinction in the infrared and of infrared absolute magnitudes were obtained. The spatial distribution of M stars was tentatively determined, showing a symmetrical distribution with distance, the maximum density occurring at about 3.4 kpc. This agrees with the results of a previous survey of the LF2 region in Cygnus. N stars are more abundant than R stars in the galactic plane in the direction of Cygnus. Author

N70-41098*# Chicago Univ., Ill.
CARBON ISOTOPE FRACTIONATION IN THE FISCHER-TROPSCH SYNTHESIS AND IN METEORITES
[1970] 15 p refs
(Grant NGL-14-001-010)
(NASA-CR-113871) Avail: NTIS CSCL 03B

Carbon dioxide and organic compounds made by a Fischer-Tropsch reaction at 400 K show a kinetic isotope fractionation of 50 to 100 per mille, similar to that observed in carbonaceous chondrites. This supports the view that organic compounds in meteorites were produced by catalytic reactions in the solar nebula. Author

N70-41170*# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.
STRUCTURAL AND SPECTRAL STUDIES OF SUNSPOTS Annual Report, 1 Sep. 1969 – 31 Aug. 1970
Arne A. Wyller 17 Sep. 1970 33 p refs
(Grant NGR-39-005-066)
(NASA-CR-113874) Avail: NTIS CSCL 03B

Results are reported from the observations of sunspot photoelectric line profiles for some of the major Fraunhofer lines: H-alpha, Na D sub 2, and Ca I lambda 4227. The He I lambda 10,830 line was recorded using an infrared photomultiplier. Particular attention was paid to the big spot groups which developed October 18 to 26 and reappeared in the latter half of November. On both occasions, pressure scans of these lines were made for selected spots with the echelle alone at a resolution of 0.10 - 0.15 A. Author

N70-41181*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF RETROROCKET CANT ANGLE ON GROUND EROSION: A SCALED VIKING STUDY
Leonard V. Clark Washington Oct. 1970 25 p refs
(NASA-TM-X-2075; L-7376) Avail: NTIS CSCL 22A

An experimental study was conducted to evaluate the relative merits of canting the Viking lander retrorockets toward the spacecraft center line as a means of reducing rocket-exhaust disturbance of the surface of Mars. A description is given of the

experimental study and the scaling scheme of the test. A brief discussion of significant data trends is included. The results indicate that canting of the retrorockets toward the center of the spacecraft does reduce ground erosion of the landing site from that produced by a lander configuration with downward-directed retrorockets. Before canting the Viking lander retrorockets, it will be necessary to weigh this reduction in surface disturbance against the attendant loss of thrust due to canting. Author

N70-41194*# Bellcomm, Inc., Washington, D.C.
TRANSFORMATION OF A POTENTIAL FUNCTION UNDER COORDINATE TRANSLATIONS
S. L. Levie, Jr. 13 Aug. 1970 21 p refs
(Contract NASw-417)
(NASA-CR-113947; TM-70-2014-7) Avail: NTIS CSCL 03C

Starting with a potential function written as an infinite series of spherical harmonics, the coordinate system to which the potential is referred is given a pure translation. Known transformation properties of spherical harmonics are then used to produce an equivalent series valid in the new system. The procedure yields expressions for the series coefficients in the new system, showing them to be linear combinations of the old coefficients. Two applications are discussed. One involves modeling the contribution of mascons to the lunar potential, and the other involves the study of complete earth perturbations on a high-altitude lunar satellite. Author

N70-41222# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Geo-Astrophysics Section.
SIMULATION OF SURFACE-ATMOSPHERE INTERACTION PROCESSES FOR MARS
K. M. Foreman Aug. 1970 27 p refs Presented at ASTM/IES/AIAA Simulation Conf., Gaithersburg, Md., 14-16 Sep. 1970
(RM-483J) Avail: NTIS

To understand the convective motion and effect of surface topography and soil on local atmospheric motion, a laboratory-scale simulator was designed and built to examine parameters of significance systematically. Scaling law relationships were used in sizing the 4 ft diam. by 8 ft high stainless steel facility; appropriate test conditions, to about 10 microns absolute pressure and gas temperatures between −85 and +65 C, can be maintained within the terrestrial gravitational environment. Measurements of test gas temperature above the simulated planetary surface are made with a specially designed traversing mechanism carrying thin film and thermistor sensors. Temperature profiles above the surface are similar to theoretical calculations for equatorial Mars regions at midmorning. Additional data show that temperature gradients increase near the surface as the gas pressure is decreased below atmospheric level, and that the degree of turbulence appears to diminish with lower pressure. Exploratory tests of thin film sensors as wind speed indicators at simulated Mars surface pressure of 5 mb show possible difficulty in differentiating velocity from temperature at wind speeds less than several m/sec. magnitude. Author

N70-41236*# GCA Corp., Bedford, Mass. Technology Div.
EXPERIMENTAL AND THEORETICAL STUDIES IN PLANETARY AERONOMY Final Report
F. F. Marmo Jul. 1970 174 p refs
(Contract NASw-1726)
(NASA-CR-113882; GCA-TR-70-8-N) Avail: NTIS CSCL 03B

The overall problems associated with the physics of planetary atmospheres and the broad variety of scientific areas which have been considered are discussed under the categories: experimental studies and theoretical studies. Author

N70-41239*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
DISCRETE LEVELS OF BEGINNING HEIGHT OF METEORS IN STREAMS
A. F. Cook 8 Sep. 1970 28 p refs
(Grant NGR-09-015-004)
(NASA-CR-113948; SAO-SPECIAL-REPT-324) Avail: NTIS CSCL 03B

Of the 26 streams of meteors classified according to Ceplecha's discrete levels of beginning height, 13 are associated with known comets. Comet Biela produced in the Andromedids a double-peaked distribution (Classes A and C sub 1). Apparently no known coments produce a stream of Class B. Consideration of Whipple and Stefanik's model of an icy conglomerate nucleus with radioactive heating and redistribution of ice leads to association of Ceplecha's Class C with the residue of the ice-impregnated surface of a cometary nucleus after sublimation of the ices, and the Ceplecha's Class A with the core of a cometary nucleus. Class B meteoroids are then to be associated with less dense cores of smaller cometary nuclei that have lost their surfaces and are too small to have been observed. Furthermore, the density of Class A meteoroids is so close to that of Type I carbonaceous chondrites as to suggest that the latter come from one cores of very large nuclei of comets, an idea originally proposed by McCosky and Ceplecha. The research reported considers the streams classified by Ceplecha as well as the identifications of streams more recently proposed by others in the field. Author

N70-41244# Aerospace Corp., El Segundo, Calif. Lab. Operations.
CORRELATION BETWEEN SOLAR X-RAY LINE EMISSION AND SOLAR RADIO EMISSION, JUNE 1969 – APRIL 1970
Hugo R. Rugge, Arthur B. C. Arthur, Jr., and M. Anderson (AF Inst. of Tech.) 15 Jul. 1970 24 p refs
(Contract F04701-70-C-0059)
(AD-709205; TR-0059(9260-02)-1; SAMSO-TR-70-259) Avail: NTIS CSCL 3/2

The intensities of a number of solar x-ray emission lines in the 8- to 25-A region have been compared to solar-radio emissions at several wavelengths to search for a correlation between the two and to try to identify a slowly varying component of the x-ray emission lines. The x-ray measurements were made from the OV1-10 satellite from December 1966 to June 1967 with a Bragg crystal spectrometer. The radio measurements at six frequencies between 606 and 8800 MHz were taken from reports in the literature. In general, the highest correlation coefficients (r is about 0.80) occur at the longer radio wavelengths for the shortest x-ray wavelengths, and the shorter x-ray wavelengths correlate best with the shortest radio wavelengths. The high correlation coefficients obtained strongly suggest a close relationship between the radio and x-ray emissions. These highly correlated x-ray and radio emissions are referred to as the slowly varying component. The same active regions appear to be responsible for both the radio and x-ray emissions. Author (TAB)

N70-41296# Naval Observatory, Washington, D.C. Nautical Almanac Office.
EPHEMERIS OF THE SUN, POLARIS AND OTHER SELECTED STARS WITHIN COMPANION DATA AND TABLES FOR THE YEAR 1970
1970 36 p
(AD-709408) Avail: NTIS CSCL 3/1

The arrangement of the astronomical data herein conforms to the methods and examples for the determination of time, latitude, and azimuth, practiced by the cadastral engineers of the Bureau of Land Management. These practices are described in the Manual of Instructions for the Survey of the Public Lands of the United States. The methods long in use have been developed for the best operation of the improved solar transit, in combination with observations on the sun, Polaris, and the brighter equatorial stars, for the determination and verification of time, latitude, and azimuth. In this practice, the data for the sun are required in terms of daily apparent positions for the Greenwich meridian; for all

stellar positions in terms of the Greenwich meridian, mean time, and mean time intervals. The apparent time of sunrise and of sunset, the refractions in polar distance, and the companion trigonometric tables and formulas employed in these methods, are tabulated in the Standard Field Tables of the Bureau of Land Management. Author (TAB)

N70-41340*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.

PRECISE LOCATION OF SAGITTARIUS X RAY SOURCES WITH A ROCKET-BORNE ROTATING MODULATION COLLIMATOR

H. W. Schnopper, H. V. Bradt, S. Rappaport, E. Boughan, B. Burnett et al 1970 18 p refs

(Contract NSR-22-009-129; Grant NGL-22-009-015)

(NASA-CR-113922; CSR-P-70-40) Avail: NTIS CSCL 03A

The celestial positions of four X-ray sources in the Sagittarius region were measured with high precision (about 1 inch to 2 inches). The experiment was performed with two independent rocket-borne rotating modulation collimators backed with proportional counter detectors sensitive in the 1.5 to 8 keV energy range. High precision aspect data were obtained by star photography which was directly referenced to the collimator grids. Author

N70-41385# Technische Univ., Berlin (West Germany).

ON THE EXACT CALCULATION OF SPACE TRAJECTORIES [ZUR GENAUEN BERECHNUNG VON RAUMFLUGBAHNEN]

Hartmut Schwermer (Ph.D. Thesis) 1968 135 p In GERMAN

Avail: NTIS

A mathematical model for space trajectories in the planetary system is developed and three differential equations of the second order are formed which describe the motion of a spaceship in interplanetary space. An approximative solution for the differential equations with error correction delivers multiple structural diagrams. Also formulated is a numerical solution for spaceship motion subjected to gravitational forces. Transl. by G.G.

N70-41480*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NATURAL ENVIRONMENT CRITERIA FOR THE NASA SPACE STATION PROGRAM (SECOND EDITION)

Don K. Weidner ed. 20 Aug. 1970 257 p refs Revised

(NASA-TM-X-53865) Avail: NTIS CSCL 03B

CONTENTS:

1. PRELAUNCH, LAUNCH AND INFLIGHT ENVIRONMENT p 3-28 refs (See N70-41481 23-13)
2. EARTH ORBITAL ENVIRONMENT p 29-76 refs (See N70-41482 23-13)
3. INTERPLANETARY SPACE ENVIRONMENT p 77-90 refs (See N70-41483 23-30)
4. LUNAR ENVIRONMENT p 91-105 refs (See N70-41484 23-30)
5. MARTIAN ENVIRONMENT p 107-136 refs (See N70-41485 23-30)
6. VENUS ENVIRONMENT p 137-153 refs (See N70-41486 23-30)

N70-41483*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

INTERPLANETARY SPACE ENVIRONMENT

In its Nat. Environment Criteria for the NASA Space Sta. Program (2d ed.) 20 Aug. 1970 p 77-90 refs (See N70-41480 23-30)

Avail: NTIS CSCL 03B

Natural environmental criteria are outlined for preliminary NASA space station studies of interplanetary space and the Earth to Mars mission. Atmospheric gas properties and radiation, as well as meteoroids, asteroids, comets, and magnetic fields are discussed. Tables of orbital elements for major meteor streams, asteroids, and comets are included with a graph of the average relative velocity of cometary particles. J.M.

N70-41484*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

LUNAR ENVIRONMENT

In its Nat. Environment Criteria for the NASA Space Sta. Program (2d ed.) 20 Aug. 1970 p 91-105 refs (See N70-41480 23-30)

Avail: NTIS CSCL 03B

Natural lunar environmental criteria are provided for NASA space station and launch vehicle studies based on pre-Apollo 11 data and analysis of Apollo 11 lunar samples. Lunar atmospheric properties are described including gas pressure, density, and composition, galactic, trapped, and thermal radiation, solar proton events, meteoroid and flux-mass models, magnetic fields, and the lunar surface. J.M.

N70-41485*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MARTIAN ENVIRONMENT

In its Nat. Environment Criteria for the NASA Space Sta. Program (2d ed.) 20 Aug. 1970 p 107-136 refs (See N70-41480 23-30)

Avail: NTIS CSCL 03B

Martian atmospheric and surface properties are presented for NASA space station and launch vehicle studies of Martian missions. The atmospheric environment is described including gas temperature, composition, surface pressure, and model atmospheres. Martian winds, clouds, and blue haze are also covered. The ionosphere, galactic cosmic, trapped, planetary, solar thermal, and albedo radiation, and solar proton events are summarized. The meteoroid environment near Mars and a flux-mass model are mentioned as well as magnetic fields and astrodynamic constants. Tables of Mars maximum, mean, and minimum model atmospheres are given with winds, clouds, and profiles of temperature, molecular weight, and atmospheric density. J.M.

N70-41486*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

VENUS ENVIRONMENT

In its Nat. Environment Criteria for the NASA Space Sta. Program (2d ed.) 20 Aug. 1970 p 137-153 refs (See N70-41480 23-30)

Avail: NTIS CSCL 03B

Venus environmental criteria are presented for NASA space station and launch vehicle studies relative to the Venus Flyby Mission, based on atmospheric measurements and speculations. Gas properties including temperature, composition, surface pressure, and atmospheric models are discussed as well as atmospheric circulation and clouds. The ionosphere, galactic, trapped, thermal, and albedo radiation, and solar proton events are covered. The meteoroid environment near Venus and a flux-mass model are also summarized along with magnetic fields, astrodynamic constants, and surface properties. Tables of Venus model atmospheres are given. J.M.

N70-41559*# Bureau of Mines, Minneapolis, Minn. Mining Research Center.

MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Annual Status Report, FY 1970

1 Jul. 1970 34 p refs

(NASA Order R-09-040-001)

(NASA-CR-113920) Avail: NTIS CSCL 22A

Simulated lunar environment investigations were conducted to determine possible uses of rocks and minerals in future space missions. Topics discussed are: (1) surface properties of rocks and

minerals, (2) failure processes, strength, and elastic properties of rocks, (3) thermal fragmentatiion, thermophysical, and optical properties, (4) use of explosives on the moon, (5) lunar environment effects on behavior of fine particles, and (6) electrowinning of oxygen from silicate rocks. An ultrahigh vacuum drill was also developed and used in the investigation. E.H.W.

N70-41762# Air Force Cambridge Research Labs., Bedford, Mass.
STUDY OF SPECTROHELIOGRAMS IN METAL LINES AND THE CHROMOSPHERE STRUCTURE
E. E. Dubov Apr. 1970 30 p Transl. into ENGLISH from Akad. Nauk SSSR, Krymsk. Astrofizicheskaya Observ. Izv. (USSR), No. 69, 1969 p 179–194
(AD-709356; AFCRL-70-0272; AFCRL-TRANS-78) Avail: NTIS CSCL 3/2

Distributions of bright and dark parts of spectroheliograms obtained in metal lines (FeI 4202 A, 4384 A, CaI 4227 A, SrII 4078 A, NaI 5890 A and K3CaII) at different distances from line centers are compared. It is concluded that these brightness distributions do not contradict the idea on the structure of the chromosphere which were developed by the author in Dubov, (1967). The brightness distributions on metal lines in spectroheliograms mainly reflect the structure of the velocity fields in the photosphere and the distribution of photospheric faculae in active regions. Ascending motions are observed mostly near boundaries of supergranules (except for the D2NaI line). The stronger the line, the greater is the influence of the structure of the atmosphere on the brightness distribution on the corresponding spectroheliogram. This effect is expressed most clearly on the Na 5890 A line. The descent of matter (as in H sub alpha) is observed most frequently on this line near the boundaries of super-granules. According to the brightness distributions on spectroheliograms which were taken on the ionized strontium 4078 A line, it can be assumed that both relatively deep layers of the photosphere and a rather high layer of the chromosphere take part in the formation of the outgoing radiation on this line. Author (TAB)

N70-41767*# Lowell Observatory, Flagstaff, Ariz.
TO ESTABLISH AND OPERATE A PLANETARY PATROL PROGRAM Status Report, 1 Jan.–30 Jun. 1970
William A. Baum 30 Jun. 1970 13 p
(Grant NGR-03-003-007)
(NASA-CR-113900; Rept-4) Avail: NTIS CSCL 03B

The 1969 Mars patrol photographs form the basis for three research programs currently in progress at the Planetary Research Center. Mapping of Martian clouds in an effort to determine cloud velocities and circulation patterns, and studies of the diurnal photometric behavior of semi-permanent Martian clouds are reported. The Jupiter patrol photographs were used to determine short term fluctuations in the longitude of the Great Red Spot. Determining vertical shear in the Jovian atmosphere by measuring the relative motion of features having the same latitude but different colors is another feature of the program reported. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N70-40695*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-64, VOLUME 1 FOR THE PERIOD 1 MAY TO 30 JUNE 1970. FLIGHT PROJECTS
31 Jul. 1970 46 p refs
(Contract NAS7-100)
(NASA-CR-113720; JPL-SPS-37-64-Vol-1) Copyright. Avail: NTIS CSCL 22A

CONTENTS:
1. MARINER MARS 1971 PROJECT p 1–29 refs (See N70-40696 23-31)
2. VIKING PROJECT, ORBITER SYSTEM AND PROJECT SUPPORT p 30–41 ref (See N70-40697 23-31)

N70-40696*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1971 PROJECT
In its Space Programs Sum. No. 37-64, Vol. 1, May–Jun. 1970 31 Jul. 1970 p 1–29 refs (See N70-40695 23-31)
Copyright. Avail: NTIS CSCL 22A

The project will measure atmospheric and surface parameters of Mars at different times and locations to determine the dynamic and physical characteristics of Mars. Two missions are planned for the experiment. Mission A will map the topography at a higher resolution than previous missions, and perform measurements of the composition, density, pressure, and thermal properties of the atmosphere. Other measurements will take surface temperatures, composition and thermal properties, mass distribution, shape, and lack of internal activity. Mission B will seek data on Mars' surface associated with wave darkening where both seasonal and secular changes occur. Atmospheric structure and gross dynamics information will also be obtained. A description of equipment and the modifications made on the spacecraft is included. E.H.W.

N70-40697*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VIKING PROJECT, ORBITER SYSTEM AND PROJECT SUPPORT
In its Space Programs Sum. No. 37-64, Vol. 1, May–Jun. 1970 31 Jul. 1970 p 30–41 ref (See N70-40695 23-31)
Copyright. Avail: NTIS CSCL 22A

The Viking spacecraft will be designed to detect life and the ability of Mars to support life. An orbiter system will transport and inject the lander system to the landing site and relay data back to earth. The orbiter will also measure atmospheric and surface parameters, map the planet's topography with special emphasis on mapping the proposed landing site prior to deorbit and supporting the lander after it lands. Visual and infrared coverage is planned. The lander system will measure, during entry, Mars atmospheric composition, temperature, pressure and density. After landing, surface composition, temperature, pressure, humidity, and wind speed will be measured. E.H.W.

N70-40784*# North American Rockwell Corp., Downey, Calif. Space Div.
LUNAR ESCAPE SYSTEMS (LESS) FEASIBILITY STUDY, VOLUME 2 Final Technical Report
J. O. Matzenauer Washington NASA Sep. 1970 595 p refs
(Contract NAS1-8923)
(NASA-CR-1620; SD-69-598) Avail: NTIS HC $10.00/MF $0.85 CSCL 06G

The basic LESS concept of a relatively simple system for carrying two astronauts to a safe orbit was found to be feasible technically and operationally. Trajectory data and boost profile characteristics were developed for a variety of possible ascent profiles and conditions. Sensitivity of these trajectories to controllable and uncontrollable variables was evaluated. An interesting variant of the conventional ascent trajectory profiles was posed as the bent two-step profile combining good performance with simplicity. Rendezvous requirements for simple LESS concepts were evaluated and found to be compatible with existing CSM capabilities. Visibility problems and sun-angle phenomena were examined for missions

of 3, 7, and 14-day stay-times. The resulting wide range of possible sun angles has been analyzed to identify problems with guidance elements and vehicle rendezvous operations. Author

N70-40793# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BALLISTIC MISSILES
L. N. Pronin 24 Apr. 1970 127 p Transl. into ENGLISH of the book 'Ballisticheskiye Rakety' Moscow, Izd-Vo Ministerstva Oborony SSSR, 1969 p 1–111
(AD-708446; FTD-MT-24-57-70) Avail: NTIS CSCL 16/4

The booklet describes the general working principles of modern ballistic missiles for military purposes and carrier-rockets for space objects; their classification and methods of flight control are described, the employment of ballistic missiles in combat actions on land and on sea is narrated, and the leading role of the Soviet Union in rocket building is brought to light. Author (TAB)

N70-40951*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE TRANSPORTATION SYSTEM TECHNOLOGY SYMPOSIUM. VOLUME 6: INTEGRATED ELECTRONICS (INCLUDING ELECTRIC POWER)
Jul. 1970 376 p refs Symp. held at Cleveland, 15–17 Jul. 1970
(NASA-TM-X-52876-Vol-6; E-5866-Vol-6) Avail: NTIS CSCL 22B

Research and development of electronic equipment for space shuttle vehicles is discussed, including integration of avionics systems, onboard data processing and management, terminal navigation and guidance, laser and solid state communication devices, computerized imaging techniques for approach and landing control, and electric power systems. For individual titles see N70-40952 through N70-40975. For volume 1 see N70-37826 through N70-37847, for volume 2 see N70-36595 through N70-36615, for volume 4 see N70-39626 through N70-39637, and for volume 5 see N70-39603 through N70-39616.

N70-40952# Boeing Co., Seattle, Wash.
INTEGRATED AVIONICS ARCHITECTURE
D. M. Petrie *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 7–28 (See N70-40951 23-31)
Avail: NTIS CSCL 22B

An integrated avionics system is described that is characteristic of that which will be found in future aircraft and manned space vehicles. The design approach points out the need to avoid generalities in use of design rules; rather, that the details of the question at hand should be used to reach configuration decisions. The system design represents a mix of centralized/decentralized concepts and covers the redundancy question. Subsystem elements that are described include a central data management computer, data bus, CRT displays, manual interface, navigation sensors, flight control, rocket engine control, and telecommunications. Traditional approaches to system organization and subsystem design practice must be altered in order for the new approach to be successful. Development program requirements should include a breadboard demonstrator connected to peripheral electromechanical equipment and a test bed airplane. Author

N70-40953*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SIMULATION OF THE SHUTTLE SUBSYSTEMS MANAGEMENT AND CONTROL FUNCTION
Michael A. Cowan and David J. Freeman *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 29–49 (See N70-40951 23-31)
Avail: NTIS CSCL 22B

The controls and displays of the integrated avionics system for the space shuttle are discussed and the technology requirements for the system are outlined. The control and display interface includes the flight control subsystems and the controls and displays to manage and operate shuttle subsystems. The largest subsystems are the flight control, propulsion, and avionics subsystems. Each of the subsystems are described and illustrated. R.B.

N70-40955*# Boeing Co., Seattle, Wash.
INTEGRATED CONTROL AND AIRFRAME DEVELOPMENT CONSIDERATIONS
Donald L. Martin *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 67–84 (See N70-40951 23-31)
Avail: NTIS CSCL 22B

Analytical models, simulation, and laboratory hardware are discussed with respect to integrating the guidance and control systems of the space shuttle with the airframe. Examples are taken from the SST prototype development program to illustrate the technology considerations and design requirements. R.B.

N70-40959*# General Dynamics/Convair, San Diego, Calif.
CHECKOUT OF REDUNDANT SYSTEMS
H. L. Newman *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 115–131 (See N70-40951 23-31)
Avail: NTIS CSCL 22A

Present analytical tools, such as failure mode and effect analysis used in the design process, are of limited usefulness for integrated checkout systems in a redundant environment. Space shuttle requirements are considered with respect to factors introduced by onboard checkout and redundant hardware/software systems configured to be fail operational and fail safe. A rational approach is discussed with emphasis on the problems of utilizing the classical methods. Some of the inadequacies are explained and several possible approaches outlined. Author

N70-40964*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
GUST ALLEVIATION AND MODAL SUPPRESSION CONTROL TECHNOLOGY
Mario H. Rheinfurth *In its* Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 193–208 refs (See N70-40951 23-31)
Avail: NTIS CSCL 22B

A necessary condition for satisfactory flight performance of an aerospace vehicle is to keep its responses due to atmospheric disturbances within the design limits of the control deflections and the structural loads of the vehicle. This task is solved in two ways: proper design of the vehicle configuration such that aerodynamic lift and moment coefficients are minimized, and judicious selection of a controller which provides gust alleviation during those periods of flight when aerodynamic disturbances become severe. A method of designing a controller which will actively control both rigid body and flexure modes is described. This objective is met by formulating the problem as a stochastic minimization problem. The atmospheric disturbances and the vehicle responses are described as random processes and the probability of mission failure is defined. In order to render the problem mathematically tractable, the stochastic problem was reformulated in a manner that permits application of quadratic optimum control theories. Author

N70-40965*# Honeywell, Inc., Minneapolis, Minn.
ACTIVE FLEXURE CONTROL TODAY
G. B. Skelton *In* NASA. Lewis Res. Center Space Transportation System Technol. Symp., Vol. 6 Jul. 1970 p 209–226 refs (See N70-40951 23-31)
Avail: NTIS CSCL 22B

Active control of flexure degrees of freedom is discussed as a means of solving the aeroelasticity problems of space shuttle vehicles. Bandwidth and bandwidth limits and the three flexure control methods which have been flight tested are described. R.B.

N70-41035* # National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN ANALYSIS OF POTENTIAL ORBITAL PROPELLANT STORAGE REQUIREMENTS AND MODES OF OPERATION
Walter E. Whitacre 1 Jul. 1970 25 p refs
(NASA-TM-X-64538) Avail: NTIS CSCL 22A

An attempt is made to indicate the status of orbital propellant storage requirements and modes of operation. The problems connected with long-term storage and orbital propellant transfer are discussed and some tentative recommendations are presented. Author

N70-41050# Boston Coll., Chestnut Hill, Mass. Space Data Analysis Lab.
SATELLITE ATTITUDE DETERMINATION FROM SOLAR AND MAGNETIC SENSORS Final Scientific Report, 1 Feb. 1969 - 28 Jan. 1970
Rene J. Marcou and Paul N. Pruneau 28 Feb. 1978 91 p refs
(Contract F19628-69-C-0114)
(AD-709250; AFCRL-70-0317) Avail: NTIS CSCL 22/1

The computation of meaningful aspect parameters for each OV3-2, OV1-15 and OV3-6 orbit of interest was arrived at by using a general aspect analysis and computer programs. For this purpose, both raw magnetometer and sun sensor telemetry data merged with the corresponding ephemeris data were used. This aspect information represents a history of these satellites. Author (TAB)

N70-41343*# GCA Corp., Bedford, Mass. Technology Div.
DEFINITION OF EXPERIMENTAL STUDIES FOR DETERMINING GASEOUS AND PARTICULATE CLOUD ENVIRONMENT OF MANNED SPACECRAFT AND APPLICATIONS TO COMETARY PHYSICS Final Report
J. Pressman, J. Myers, and P. Lilienfeld May 1970 163 p refs
(Contract NASw-1745)
(NASA-CR-113894; GCA-TR-70-2-N) Avail: NTIS CSCL 22A

The nature and behavior of effluents from spacecraft and possible applications to cometary problems are surveyed. A kinetic model is developed for some aspects of effused gas surrounding a spacecraft. An experiment for cometary physics is suggested in which a satellite releases ammonia, hydrazine, and rodine ozanide. Two single satellite experiments are suggested for measuring the pollutants around the spacecraft. The first is a particle measurement experiment which has the capability of measuring the particle concentration and size as a function of distance from the spacecraft. The second experiment utilizes a monopole mass spectrometer to measure, in particular, the heavy molecular weight component of the effused molecules. The general structure and a series of experiments are designed for a sub-satellite program to measure the pollution around a spacecraft. Author

N70-41373* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RADIAL MODULE SPACE STATION Patent
Owen E. Maynard, Willard M. Taub, David Brown, Edward H. Olling, and Robert M. Mason, inventors (to NASA) Issued 24 Jan. 1967 (Filed 20 Jan. 1964) 10 p Cl. 244-1
(CASA-Case-XMS-01906; US-Patent-3,300,162; US-Patent-Appl-SN-339040) Avail: US Patent Office CSCL 22B

A manned space station is described which can be stored in complete assembled form in the payload stage of a multistage launch rocket for ejection into an earth orbit and which is erectable into an operating configuration of a group of living and working compartments. The space station consists of three elongate rigid cylindrical modules, each of which, when the station is fully erected, extends radially from a central hub structure which includes hangar and docking facilities for spacecraft. When deployed the station is rotated about the hub structure to provide stability and to produce an artificial gravity in the radial module structures, the amount of gravity being directly proportional to the distance of the module from the rotation axis. Access tubes connect each compartment of the modules to the hub structure in the event of emergency and to facilitate movement of supplies and equipment. R.B.

N70-41455* # National Aeronautics and Space Administration, Washington, D.C.
US MANNED SPACE FLIGHT: THE MANNED FLIGHT PROGRAM, THE ASTRONAUTS
[1970] 34 p
(NASA-TM-X-66349) Avail: NTIS CSCL 22A

Mercury, Gemini, and Apollo manned flight program data are compiled under the following headings: missions through Apollo 13, costs, Apollo historical summary, Apollo flight crews, origins of NASA, its budget and personnel history, astronauts on flight status, astronauts by selection groups, current status of astronauts, qualifications and fatalities, and Apollo 11 highlights. E.C.

N70-41588* Douglas Aircraft Co., Inc., Santa Monica, Calif.
RECOVERABLE SINGLE STAGE SPACECRAFT BOOSTER Patent
Philip Bono, inventor (to NASA) Issued 3 Jan. 1967 (Filed 16 Jun. 1964) 10 p Cl. 244-1 Sponsored by NASA
(NASA-Case-XMF-01973; US-Patent-3,295,790; US-Patent-Appl-SN-375682) Avail: US Patent Office CSCL 22D

The design of a single stage-to-orbit recoverable, reusable vehicle capable of injecting large payloads into circular earth orbit is described. The booster has parallel, individually separable liquid hydrogen propellant tanks mounted about the booster main body which houses a single spherical liquid oxygen oxidizer tank and an annular segmented isentropic plug nozzle rocket engine. Portions of the fuel in the auxiliary main body tanks are used for injection of the booster into orbit, ejection of the main body from orbit after the payload section is separated, and finally for retro-thrust during land recovery. The fuel tanks, which land in the ocean, and the booster main body have parachutes for reducing the terminal velocity. N.E.N.

N70-41631* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
HYPERSONIC REENTRY VEHICLE Patent
Edward E. Mayo and Robert H. Lamb, inventors (to NASA) Issued 31 Jan. 1967 (Filed 31 Dec. 1964) 7 p Cl. 244-1
(NASA-Case-XMS-04142; US-Patent-3,301,507; US-Patent-Appl-SN-422865) Avail: US Patent Office CSCL 22B

A design configuration for the heat shield portion of a reentry vehicle operating at hypersonic velocity is described. The specific shape of the forebody structure may be varied to allow reentry at specific velocities within the hypervelocity range while retaining both longitudinal and directional stability characteristics. The heat shield portion of the vehicle is raked off to produce the necessary lift-to-drag ratio and the shape of the forebody determines the reentry trajectory. R.B.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N70-40401# Laboratorio de Acoustica e Sonica, Sao Paulo (Brazil).
ACOUSTICAL EMISSION NDT INSPECTION [EMISSAO ACUSTICA NA INSPECAO NAO DESTRUTIVA]
L. X. Nepomuceno and H. Onusic [1969] 21 p refs In PORTUGESE
(Rept-7001/E-013) Avail: NTIS

The development of procedures for using acoustical emissions for nondestructive testing is investigated. The phenomenon of acoustical emission is described and a theoretical model which explains the experimental data is given. The methods for detecting fractures and deformation in materials is described. Examples of the analysis of fractures and the determination of critical loads for structures is included. Transl. by F.O.S.

N70-40446# General Technology Corp., Lawrenceville, N.J.
STRUCTURAL ANALYSIS OF PRESSURE HULLS RIB-STIFFENED CYLINDRICAL SHELL WITH REINFORCED CIRCULAR PENETRATION
Richard F. Maye and Lui M. Habip Dec. 1969 46 p refs
(Contract Nonr-4835(00))
(AD-709103; TR-7-4) Avail: NTIS CSCL 13/10

The main results of a structural analysis program concerning a conventional submarine pressure hull configuration consisting of a rib-stiffened cylindrical shell with a reinforced circular penetration under hydrostatic pressure are discussed. The mathematical solution in series form has been obtained by superposing the analytical solutions for a long, unstiffened, and unperforated circular cylindrical thin shell, closed at the ends, under external hydrostatic pressure, a long, unstiffened, and unperforated circular cylindrical thin shell under a prescribed number of arbitrary radial line loads, and a long, unstiffened, circular cylindrical shallow thin shell under arbitrary loading along the boundary of a circular penetration. During the computation, following truncation of the series, the method of least squares is employed in solving for the integration constants determined by the boundary conditions prescribed along the ribs and the reinforced penetration. The analysis has been coded and the numerical results generated by the use of a digital computer for an unstiffened as well as a rib-stiffened shell with a reinforced penetration are presented and compared graphically with experimental data available from certain photo-elastic model tests. The corresponding zone of influence of the penetration and the state of stress concentration about it are delineated. Author (TAB)

N70-40473# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
PETROS 2: A NEW FINITE-DIFFERENCE METHOD AND PROGRAM FOR THE CALCULATION OF LARGE ELASTIC-PLASTIC DYNAMICALLY-INDUCED DEFORMATIONS OF GENERAL THIN SHELLS
Luigi Moreno, John W. Leech, and Emmett A. Witmer Dec. 1969 229 p refs
(Contract DAADO5-68-C-0314)
(AD-708773; ASRL-TR-152-1; BRL-CR-12) Avail: NTIS CSCL 20/11

The equations of motion, strain-displacement relations, and the constitutive relations for a thin Kirchhoff shell of arbitrary shape and derived in tensor notation. Taken into account are arbitrarily-large deformations, and material which exhibits elastic, elastic-plastic, strain hardening, and/or strain-rate sensitive behavior also the shell may be subject to arbitrary initial velocities and/or transient external forces. The governing differential and algebraic equations then are recast into finite-difference form. These finite-difference equations have been employed to write a FORTRAN IV computer program called PETROS 2. Applications to illustrate various features of this formulation and program are presented. Included herein is the PETROS 2 program together with sample problem input and solution data. Subroutines which will handle shells having the following initial geometries are included: (1) cone, (2) cylinder, and (3) flat plate. The user may readily provide a similar initializing subroutine to permit analyzing a shell of some other initial shape. Author (TAB)

N70-40515# Watervliet Arsenal, N.Y. Benet Labs.
A COMPLIANCE K CALIBRATION FOR A PRESSURIZED THICK-WALL CYLINDER WITH A RADIAL CRACK
John H. Underwood, Ralph R. Lasselle, Raymond D. Scanlon, and Moayyed A. Hussian May 1970 33 p refs
(AD-708868; WVT-7026) Avail: NTIS CSCL 13/4

The K calibration for an internally pressurized, thick-wall cylinder with a straight, radial notch has been determined from a compliance test. The method suggested by Irwin is used with compliance defined as the change in internal volume of a cylinder divided by applied hydrostatic pressure rather than the usual load-elongation definition. The derivative of internal volume change with respect to notch depth, a, is obtained by numerical analysis of tangential strain measurements on the OD of the test cylinder. This derivative leads directly to the K calibration for the cylinder. Cubic spline functions are used to approximate both the strain as a function of position on the cylinder and the resulting volume change as a function of a. Also included in the determination of K is a proof, using the divergence theorem in the theory of elasticity, that the derivatives with respect to a of internal and external volume change are identical. This allows the use of external strain measurements to determine K based on internal volume change. Author (TAB)

N70-40531 Catholic Univ. of America, Washington, D.C.
DYNAMIC RESPONSE OF NON-UNIFORM CIRCULAR CYLINDRICAL SHELLS STIFFENED BY NON-UNIFORM RINGS
Nicholas Leonidas Basdekas (Ph.D. Thesis) 1969 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-18582

The undamped dynamic response of a submarine-like circular cylindrical shell of nonuniform thickness stiffened by nonuniform rings, floor girders and sets of tubes of arbitrary spacings and having attached masses is considered. The mode shapes and frequencies of an unstiffened circular cylindrical shell of uniform thickness are utilized in conjunction with the minimization of the incremental variational integral. Truncated systems of equations are integrated numerically. The main feature of the loading considered is that its frequency is a function of the absolute value of the circumferential variable theta. For this loading the sensitivity of the dependence of the radial displacement of the radiation of the forcing function is investigated and the convergence of the maximum radial displacement with the increase of the size of the truncated system of the differential equations is studied. It is found that the convergence is very good and that the response is quite sensitive to the spatial dependence of the frequency of the forcing function. Dissert. Abstr.

N70-40595# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
AN APPLICATION OF THE FINITE ELEMENT METHOD TO ELASTIC-PLASTIC PROBLEMS OF PLANE STRESS
L. Berke, R. Sandhu, and M. Salmon (IIT Res. Inst., Chicago) May 1970 57 p refs
(AD-708516; AFFDL-TR-68-39) Avail: NTIS CSCL 13/13

A computer program is presented for the small strain analysis of plane structures in the strain hardening elastic-plastic range. The finite element displacement method is used to perform the linear analyses in the iterative scheme. Bar and constant strain isotropic plane stress triangles are available for use in constructing structural idealizations. The use of ten different sets of material properties, three different material laws, and incremental proportional loading are available as options. Good correlation is shown with available test data and theoretical solutions. Author (TAB)

N70-40641 California Univ., Berkeley.
PLASTIC DEFORMATION AND PERFORATION OF THIN PLATES RESULTING FROM PROJECTILE IMPACT
Clarence Andrew Calder (Ph.D. Thesis) 1969 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-18890

The dynamic response of thin plates subjected to projectile impact was studied theoretically and experimentally. Projectile speeds were chosen so as to produce significant plastic deformation at the lower velocities and complete perforation at the higher velocities. Large deformation and bending theories for nonperforation, and momentum and energy relations for piercing were compared with experimental results based on surface transducers and high speed photography. Most of the experimental work was performed with 1/2 in. diam. steel projectiles, spherical or cylindro-conical in shape, centrally striking a 2024-0 aluminum plate, 0.050 thick and clamped on a 14-1/4 in. diam. at normal velocities ranging from 75 to 933 ft/sec. Peak strains, amounting to more than 2% at the 1-1/2 in. position from the impact point were recorded and found to propagate between the 1-1/2 in. and 3 in. stations at about 8800 in./sec at all impact velocities. This velocity was precisely the value found photographically for the radial growth of the plastic zone in the central region out to a radius of 1-1/2 in. Perforation occurred by means of plugging and dishing, and by petalling and dishing due to the spherical and pointed projectile, respectively. Dissert. Abstr.

N70-40645*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MECHANICAL PROPERTIES OF ADVANCED GRAVITY GRADIENT BOOMS
C. L. Staugaitis and R. E. Predmore Washington Oct. 1970 31 p refs
(NASA-TN-D-5997; G-999) Avail: NTIS CSCL 20K

The mechanical (static and dynamic) behavior of a number of boom designs applicable to gravity gradient and antenna use were investigated. Bending stiffness, critical bending moment, damping, and transverse (fundamental bending) frequency were the principal properties measured. The structural integrity of two boom designs was also evaluated when subjected to cyclic loading conditions. The results are analyzed in terms of structural performance and conformance to elastic behavior as predicted by theory for thin-walled tubes. Author

N70-40653# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
DYNAMIC BEHAVIOR AND STABILITY OF SOLIDS Final Scientific Report, 1 Dec. 1966–15 May 1970
George Herrmann 15 May 1970 12 p refs
(Grant AF-AFOSR-100-67)
(AD-708515; AFOSR-70-1650TR) Avail: NTIS CSCL 13/13

The report summarizes research results on dynamic behavior and stability of solids for the period December 1, 1966 through May 15, 1970. TAB

N70-40654*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MODAL DENSITY ESTIMATES FOR SANDWICH PANELS: THEORY AND EXPERIMENT
Larry L. Erickson Washington Sep. 1970 49 p refs
(NASA-TN-D-5771; A-3106) Avail: NTIS CSCL 20K

Formulas are presented that can be used to estimate the average modal densities of sandwich beams and flat or cylindrically curved sandwich panels. Numerical results, presented in terms of general parameters, indicate the relative importance of transverse shear flexibility, orthotropic shear moduli of the core, face bending stiffness, rotary inertia, and panel curvature over a wide frequency range. Modal densities determined experimentally from resonance tests of flat rectangular sandwich panels having orthotropic cores are close to the modal densities estimated by theory except at frequencies near that of the fundamental mode. In this low-frequency range the theoretical estimates are not valid. Author

N70-40658*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A DISCUSSION OF THE MODES OF FAILURE OF BUMPER-HULL STRUCTURES WITH APPLICATION TO THE METEOROID HAZARD
C. Robert Nysmith Washington Oct. 1970 13 p refs
(NASA-TN-D-6039; A-3562) Avail: NTIS CSCL 20K

The impact of double-sheet structures is discussed, and typical impact-curves, determined by the physical processes by which the rear sheet fails, are defined. It is concluded that, in order for a bumper-hull system to perform effectively, the front- and rear-sheet thicknesses must be larger than certain minimum limits. Tentative values for these limits are: the front sheet should be thicker than 0.25 times the diameter of the largest probable meteoroid; the rear sheet should be thicker than 0.50 times the diameter of the largest probable meteoroid; and the rear sheet should be thicker than the front sheet. Also, it is concluded that if the sheet-thickness ratios are selected according to both high- and low-speed results (observing the above thickness-ratio minimums), and the sheet spacing is selected according to low-speed results, the structure will perform satisfactorily for all probably impact conditions. Author

N70-40676*# Measurement Analysis Corp., Marina Del Rey, Calif.
DISTRIBUTED SYSTEM RESPONSE CHARACTERISTICS IN RANDOM PRESSURE FIELDS
Richard L. Barnoski and John R. Maurer Washington NASA Sep. 1970 200 p refs
(Contract NAS5-11619)
(NASA-CR-1660) Avail: NTIS CSCL 20K

The response characteristics of distributed structural systems to random excitation representative of three typical acoustic pressure fields are investigated. Emphasis is upon parametric results for response spectral density functions and the mean square response values at an arbitrary spatial location. The excitations considered are those representative of a reverberant pressure field andd aerodynamic turbulence. A random progressive wave field is included for illustration. For each of the three pressure fields, joint and cross acceptance functions are determined for a structure of one dimension. Of particular interest are closed form response results for each of the system functions where filter approximations of the excitation acceptance functions are used. Contributions of modal cross terms are shown. Author

N70-40684# Technische Univ., Berlin (West Germany). Fakultaet fuer Bauingenieurwesen.
ON THE SOLUTION FOR THE BOUNDARY VALUE PROBLEM IN THE BENDING THEORY FOR SLIGHTLY CURVED TRANSLATIONAL SHELLS OVER A RECTANGULAR GROUND CROSS SECTION [UEBER DIE LOESUNG DES RANDWERTPROBLEMS DER BIEGETHEORIE SCHWACH GEKRUEMMTER TRANSLATIONSSCHALEN UEBER RECHTECKIGEM GRUNDRISS]
Sujit Majumder (Ph.D. Thesis) 20 Dec. 1967 151 p refs In GERMAN
Avail: NTIS

A partial differential equation system, including several transfer functions, is used to solve boundary value problems for the bending theory of rectangular limited, slightly curved translational shells. Fourier type series solutions for the shell boundaries are obtained by iteration of an infinite linear algebraic equation system. Example calculations for the construction of elastic roof geometries are included. Transl. by G.G.

N70-40762# Delaware Univ., Newark. Dept. of Mechanical and Aerospace Engineering.
STRESSES IN ORTHOTROPIC SHALLOW SPHERICAL SHELLS. PART 1: ANALYTIC SOLUTION
Howard S. Klinger and Jack R. Vinson May 1970 22 p refs
(Grant AF-AFOSR-EM9-07)
(AD-708497; TR-114-Pt-1) Avail: NTIS CSCL 13/13

The behavior of isotropic shells subjected to concentrated loads has been studied for many years and is very well documented in the literature. In the last few years, however, the fabrication and use of composite and fiber reinforced plates and shells as primary structural elements has necessitated the development of methods of stress analysis for highly anisotropic materials including the effects of transverse shear deformation. As a step in that direction, the present work will consider the effects of localized loads on highly orthotropic shallow spherical shells. Author (TAB)

N70-40771* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NATURAL VIBRATION AND FLUTTER OF ELASTICALLY SUPPORTED CORRUGATION STIFFENED PANELS: EXPERIMENT AND THEORY
Walter J. Heard, Jr. and Herman L. Bohon Washington Oct. 1970 37 p refs
(NASA-TN-D-5986; L-6772) Avail: NTIS CSCL 20K

The natural vibration and flutter characteristics of two corrugation-stiffened panels were studied experimentally and theoretically to determine the effects of finite deflectional, rotational, and torsional stiffnesses of the boundary supports. Flutter tests were conducted at a Mach number of 3. The experimental data are compared with results from a flutter theory for orthotropic panels which includes the effects of finite support stiffnesses as well as uniform in-plane loading of the panel. The investigation indicates that finite deflectional, rotational, and torsional stiffnesses of the boundary supports must be accounted for in the theory in order to match experimental natural frequencies of the test panels. However, it is concluded that structural damping (neglected in the theory) strongly influenced the flutter behavior of the test panels. Furthermore, the theory shows that the addition of torsional stiffening at the supports is a definite asset for increasing flutter dynamic pressure and may be extremely important in the design of panels for application at hypersonic speeds where thermal expansion may be desired. Author

N70-40804# Aerospace Corp., San Bernardino, Calif. Technology Div.
A GENERALIZED PLAIN STRAIN ANALYSIS OF A SYSTEM OF N COAXIAL CYLINDRICAL SHELLS Technical Report, Jan. 1968 – May 1970
A. M. Rodriguez and R. Muskat 30 Jun. 1970 107 p refs
(Contract F04701-69-C-0066)
(AD-708715; TR-0066(S5820)-2; SAMSO-TR-70-223) Avail: NTIS CSCL 13/13

A generalized plain strain analysis is derived and computerized for a system of N coaxial elastic shells imbedded in a full space elastic medium. The medium is subjected to a uniform static triaxial compressive loading which produces a uniaxial strain, the axis of which is inclined at an arbitrary angle to the cylindrical axis. The method provides a design analysis tool for assessing or parametrically investigating composite coaxial cylindrical liner configurations used in hardened facility design as functions of number of liner elements, their elastic properties, their thicknesses, and the medium stiffness. The static solution developed is useful in predicting liner element and medium peak stresses and deformations which would be produced dynamically by free field ground shock waveforms of wavelength long compared to the liner diameter. The analysis is most applicable to structures in rock medium which behave elastically in the hardness regime of interest. Numerical results are presented for a typical liner configuration. Author (TAB)

N70-40808*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANALYSIS OF BENDING LOADS OF HYPERSONIC AIRCRAFT
Mark D. Ardema Washington Oct. 1970 29 p
(NASA-TM-X-2092; A-3625) Avail: NTIS CSCL 20K

The longitudinal bending moments on all-body configurations and wing-body configurations of a hypersonic aircraft are determined and compared. Bending-moment distributions are determined from idealized vehicle loadings due to a static maneuver, a dynamic gust condition, and a dynamic landing impact. Characteristics of selected nominal configurations are discussed, and parametric data are given that relate bending-moment magnitude to design load criteria and configuration parameters. The results indicate that for the nominal design load criteria there is no appreciable difference in the magnitude of the bending moments on the two nominal configurations. The maneuver and landing loads are found to be dominant for both the all-body and the wind-body configurations. Author

N70-40831# Texas Univ., Austin. Structures Fatigue Research Lab.
THE FATIGUE BEHAVIOR OF TUBULAR CONNECTIONS Progress Report, Jan. 1968 – Apr. 1970
A. A. Toprac and G. B. Louis May 1970 126 p refs
(Contract NBy-53143)
(AD-709036; SFRL-TR-P550-13) Avail: NTIS CSCL 13/11

This investigation presents the results of an experimental study on the fatigue strength of tubular connections. The specimens tested were T- and K-joints. All specimens had the same chord and brace which were 8 5/8 in. O.D x 3/16 and 3 3/4 in. O.D x 3/16 in. respectively. Thirteen T- and eighteen K- joints were tested in this program. However in the analysis of the results previous test programs carried out at the University of Texas were also considered. These previous programs include fourteen T- joints of the same geometry. To investigate whether models can be used to make fatigue studies the above mentioned results were compared to those obtained from a fatigue study of 94 T- joints of 2 1/4 in. chord. The results are presented in the form of S-N curves for T- and K- joints with best fit curves based on regression analysis. Further 90% survival curves are presented for both crack initiation and final failure. The study indicates that small size specimens might be feasible to study. The results of this investigation are compared to research carried on in Japan. The correlation of the results proved to be satisfactory. Conclusions are drawn based on all these studies. Author (TAB)

N70-40832# Naval Research Lab., Washington, D.C. Satellite Communication Branch.
A FLOW-DIAGRAM TECHNIQUE FOR TIME-VARYING COORDINATE SYSTEMS Interim Report
C. A. Bass 26 Jun. 1970 97 p refs
(AD-709078; NRL-7119) Avail: NTIS CSCL 20/11

Time-varying coordinates systems are encountered in a variety of engineering problems, examples being antenna design involving moving platforms, inertial navigation systems, and fire control systems. A flow-diagram technique applied to the study of angular position, velocity, and acceleration and to the externally applied forces and torques required for such motion facilitates problem visualization and provides insight to requirements for position control and methods of isolating the controlled member from the motion of the platform. Kinematic and kinetic problems for rigid-body motion are directly formulated into flow diagrams without intervening mathematical treatment. Simplifications are then performed at the flow-diagram level without concern for the particular problem once it has been put in this form. Both hardware and software methods are then available for directly implementing these flow diagrams. A tutorial approach to rigid-body problems in kinematics and kinetics is adopted for developing the flow-diagram

method. Emphasis is placed on problem visualization and ease and flexibility in constructing flow diagrams. Flow diagrams are applied to several two- and three-axis antenna designs. Author (TAB)

N70-40938# California Univ., Los Angeles. Dept. of Mathematics.
THE POST-BUCKLING PROBLEM FOR THIN ELASTIC SHELLS
C. G. Lange and A. C. Newell 1970 60 p refs
(Contract N00014-69-A-0200-4022)
(AD-709139) Avail: NTIS CSCL 13/13

An asymptotic integration technique is developed to describe the post-buckling behavior of thin elastic shells. The introduction of slow space and time scales directly into the shell differential equations permits a modeling of dynamic effects and a means of accounting for finite boundaries. A minimal principle is derived which exhibits the consistency of the present approach with the variational procedures of Koiter and others. Author (TAB)

N70-40945# Forest Products Lab., Madison, Wis.
BUCKLING COEFFICIENTS FOR SIMPLY SUPPORTED, FLAT, RECTANGULAR SANDWICH PANELS UNDER BIAXIAL COMPRESSION
Apr. 1970 22 p refs
(Contract F33615-70-M-5000)
(AD-708954; FSRP-FPL-135) Avail: NTIS CSCL 13/13

The report presents the derivation of formulas for the buckling coefficients of simply supported, flat, rectangular sandwich panels under edgewise (in-plane) biaxial compression loads. Author (TAB)

N70-40994# Aeronautical Research Council (Gt. Brit.).
STRESS CONCENTRATION FACTORS FOR REINFORCED ROUNDED-SQUARE HOLES IN SHEETS
A. J. Sobey 1968 25 p refs
(ARC-R/M-3546) Avail: HMSO 10s 6d; BIS $2.10

The influence of a uniformly reinforced rounded-square hole on the stress field in an infinite sheet is examined. Stress concentration factors are presented in graphical form for a wide range of corner quadrant radius and reinforcement parameters. Author

N70-41028*# Boeing Scientific Research Labs., Seattle, Wash.
RESPONSE OF AN ACOUSTICALLY LOADED PANEL EXCITED BY SUPERSONICALLY CONVECTED TURBULENCE
L. Maestrello and T. L. J. Linden May 1970 57 p refs Sponsored jointly by NASA
(NASA-CR-113879; AD-707258; D1-82-0971) Avail: NTIS CSCL 01C

Measurements were made of the wall pressure fluctuation and the response of the panel structure. The deg angle the flow downstream of the shock is separated. The wall pressure fluctuations and panel displacement are notably greater than the case without the shock present. The response of a plate clamped in a baffle is determined. The plate is coupled acoustically to a uniformly moving fluid. The boundary-layer exciting the plate does not interact with the acoustic field and is furthermore taken to be spatially uncorrelated. Finally, the radiation is determined over the solid angle of the Mach cone. The response is derived using finite Fourier transforms and then solving the resulting algebraic equation by expressing the solution expanded in a complete set of functions, a process which leads to an infinite set of linear equations. The right-hand side of this system of equations is a stochastic variable so that performing an ensemble average the resulting equation is solved for the covariance matrix which is subsequently diagonalized to yield the power spectral density in the statistically independent states (degrees of freedom). Author (TAB)

N70-41111*# Systems Exploration, Inc., San Diego, Calif.
UNSYMMETRICAL LARGE DEFLECTIONS OF EXPULSION DEVICES, TASKS 1 AND 2 Final Report
G. A. Hegemier and S. Manat-Messer Feb. 1970 156 p refs Prepared for JPL
(Contract NAS7-712)
(NASA-CR-113816; SE/68-D009(2)) Avail: NTIS CSCL 20K

The design of a bladder expulsion device subjected to constraints such as cycle life, chemical inertness, and storability is studied with emphasis on the structural aspects. Force controlled expulsion, displacement-controlled, and a combination of these modes are discussed with the geometry. Deformation of folding and pointing in bladders is analyzed. The optimum bladder material is considered to be a rib-reinforced composite of metal and polymer or elastomer, and the optimum geometry is a rib-reinforced shell of revolution. F.O.S.

N70-41231# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPLEX LOADING AND STABILITY OF SHELLS MADE FROM POLYMER MATERIALS
G. A. Teters 22 May 1970 394 p refs Transl. into ENGLISH of the book "Slozhoye Nagruzheniye i Ustoychivost Obolochek iz Polimernykh Materialov" Riga, Zinate, 1969 p 1-336
(AD-709692; FTD-MT-24-63-70) Avail: NTIS CSCL 13/13

The stability of shells and plates is investigated on the basis of the theory of deformations, taking into account the plastic and reheonomic properties of the material. According to the theory of localization of deformations, the connection between stresses and strains at an examined point is established in an auxiliary (mobile) system of coordinates, where the deformative properties of materials in different positions of this system is described with the help of various laws. Deformations in the main axes are determined by means of the functional of averaging, which ensures invariance of deformation. The results are given of experiments with short-term and long-term and also with simple and complex loading of polymer materials and alloys used in conjunction with polymer materials to make carrying constructions. Experiments conducted and analyzed confirm the basic tenets of the theory. On the basis of obtained expressions of the function of local deformations by examination of simple and complex subcritical stresses, the stability of plates and shells is investigated during plastic deformations and creep. Theoretical results are compared with data obtained in experiments with shells made of polymer materials and alloys. TAB

N70-41312# Technische Univ., Berlin (West Germany).
THE JOINING OF A CIRCULAR CYLINDRICAL PIPE TO A CIRCULAR RIGID EDGE SOLUTION FOR A MIXED BOUNDARY VALUE PROBLEM WITH THE HELP OF A SPECIAL COLLOCATION METHOD [DIE LAGERUNG DES KREISZYLINDRISCHEN ROHRES AUF EINER KREISFOERMIGEN STARREN SCHNEIDE. LOESUNG EINES GEMISCHTEN RADWERTPROBLEMS MIT HILFE EINER SPEZIELLEN KOLLOKATIONSMETHODE]
Klaus Brandes (Ph.D. Thesis) 1968 132 p refs In GERMAN
Avail: NTIS

A circular cylindrical pipe is joined to a rigid circular edge of somewhat larger radius than that of the pipe, and is subjected to loads. Increasing loads force the pipe to lean more and more onto the edge. In order to determine pressure distribution between pipe wall and edge, the mixed boundary value problem has to be changed into a stress boundary value problem. A numerical solution for this problem is found by applying a new collocation method. Transl. by G.G.

N70-41318# Technische Univ., Berlin (West Germany).
CONTRIBUTION TO THE OPTIMAL DESIGN OF CIRCULAR CYLINDRICAL SHELLS WITH SANDWICH STRUCTURE

SUBJECTED TO PRESSURE AND COMPRESSION LOADS [BELTRAG ZUR OPTIMALEN AUSLEGUNG VON KREISZYLINDERSCHALEN IN SANDWICH-BAUWEISE UNTER DRUCK- UND SCHUBBELASTUNG]

Detlef Ramdohr (Ph.D. Thesis) 1968 109 p refs In GERMAN
Avail: NTIS

Elastic stability analyses are performed on sandwich constructions of circular thin shells and thin shell sectors in order to determine reinforcement requirements for their face sheets. Optimal surface layer and core constructions show that the reinforcing material stiffness has to be sufficient to insure an optimal shell weight. Axial pressure on little or slightly curved shells requires only diagonal reinforcements; larger curved shells need isotropic face sheets. Edgewise compression conditions need shell reinforcements between the shorter boundaries (y direction). The orthotropy of honey-comb cores is best utilized when optimal stiffness directions in the core and surface layers correspond. Transl. by G.G.

N70-41321# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.

ON THE CAPACITY OF THIN CIRCULAR RODS TO WITHSTAND FLEXURAL VIBRATIONS IN THEIR CIRCUMFERENTIAL PLANE [UEBER DIE BEANSPRUCHUNG VON DUENNEN KREISBOGENSTAEBEN BEI BIEGESCHWINGUNGEN IN IHRER EBENE]

Christian Klarhoefer (Ph.D. Thesis) 1968 152 p refs In GERMAN
Avail: NTIS

Considered are those forced oscillations that are triggered by harmonic forces or loads acting at rod endings. Evaluated are probable fracture spots that could develop at sufficiently strong movements of the rod ends. A fundamental system of differential equations is formed for the oscillating mode by using the bending theory so that the bending moment is comprised of six exponential functions. Superimposition of these functions delivers all stress distributions that are possible. The load of the rod axis depends on: (1) excitation frequency; (2) opening angle of the rod; and (3) the six boundary conditions. The spot with the highest bending tension in a one end loaded rod is calculated for typical excitation values and results are shown in table form. Transl. by G.G.

N70-41351# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.

THE CALCULATION OF STRESSES IN RECTANGULAR PLATES INTO WHICH FORCES INTRUDE THROUGH RIBS [DIE BERECHNUNG DER SPANNUNGEN IN RECHTECKSCHEIBEN IN DIE KRAEFTE UEBER RIPPEN EINGELEITET WERDEN]

Karl-Heinz Hapel (Ph.D. Thesis) 1968 69 p refs In GERMAN
Avail: NTIS

Numerical methods described approximate stress peaks that form in the vicinity of intruding loads acting on reinforcing ribs of rectangular plates. The plate is subdivided by equally distanced vertical ribs into single panes and is subjected to loads acting on the ribs so that the bending moment in the field center is always zero. Described are developed bending moments and vertical load behavior. It is shown that the calculated pane stress depends on the stress conditions of the ribs. Transl. by G.G.

N70-41367* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FOLDING BOOM ASSEMBLY Patent

John P. Bauerschub, Jr., inventor (to NASA) Issued 3 Jan. 1967 (Filed 28 Aug. 1964) 7 p Cl. 214-1
(NASA-Case-XGS-00938; US-Patent-3,295,699; US-Patent-Appl-SN-392970) Avail: US Patent Office CSCL 13M

An improved unfolding boom assembly incorporating a triggered locking device for knuckle joints for positioning scientific equipment from a space probe is described. The boom is provided with individual hollow sections joined to each other by a knuckle joint. A cable is threaded through the sections passing around a pulley at each joint and fastened to a reel on a drive motor. When a command signal is received, the motor reels in the cable and the boom is unfolded. The joint contain two knuckles with a common pivot. The first knuckle has a T-catch which engages spring loaded claw wedges on the second knuckle to lock them together. N.E.N.

N70-41370* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

REINFORCING MEANS FOR DIAPHRAGMS Patent

William F. Mac Glashan, Jr., inventor (to NASA) Issued 3 Jan. 1967 (22 May 1964) 5 p Cl. 92-94 Sponsored by NASA
(NASA-Case-XNP-01962; US-Patent-3,298,285; US-Patent-Appl-SN-369640) Avail: US Patent Office CSCL 13M

A reinforcing means is described for highly flexible diaphragms which may be subjected to a pressure differential of several thousand pounds. The reinforcement consists of a ring of bridging beams underlying the flexing portion of the diaphragm. The structure housing the diaphragm and its reinforcement may be any one of several types of valves such as line or regular valves, or it may be a pressure-sensitive device such as a pressure switch. N.E.N.

N70-41395 National Lending Library for Science and Technology, Boston Spa (England).

RANDOM LOAD FATIGUE

G. Jacoby et al 1 Nov. 1969 3 p Transl. into ENGLISH from VDI-Z (West Ger.), v. 3, no. 21, 1 Nov. 1969 p 1479
(NLL-Trans-5324-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The mathematical methods suitable for studying the effects of irregular loading on fatigue strength are presented. Reference is made to the importance of the effect of the dynamic properties on an oscillatory system on the distribution of the loads, and to the possibility of analysing this effect with the aid of the theory of random functions. A description of the different ways of presenting stochastic functions by simple and multiple probability densities, by the autocorrelation function and the power spectral density is followed by a description of statistical properties for the specially important case of the Gaussian random function. The treatment of mixed distributions resulting from the superposing of random functions of differing intensity is explained, and finally the probability that a threshold value will be reached at least once after many fluctuations is derived. Author

N70-41450# Shock and Vibration Information Center (Defense), Washington, D.C.

THE SHOCK AND VIBRATION DIGEST. VOLUME 2, NUMBER 8, AUGUST 1970

Aug. 1970 35 p refs
(AD-709734) Avail: NTIS CSCL 20/11

Contents: News briefs; Reviews of meetings; Previews of meetings; Short courses; Abstracts from the current literature; (Analysis and design methods, Excitation, Phenomenology, Experimentation, Components, Systems); Book reviews; Publications of SVIC. TAB

N70-41518# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

SPHERICAL ELASTIC-PLASTIC WAVES IN SOLID MEDIA

Shabodh K. Garg Wright-Patterson AFB, Ohio ARL Apr. 1970 48 p refs
(Contract AF 33(615)-5313)
(AD-709369; ARL-70-0072) Avail: NTIS CSCL 20/11

The propagation of loading and unloading elastic-plastic waves in an ideally elastic-plastic infinite medium, containing a spherical cavity, and obeying the Tresca yield condition is considered when a time dependent pressure pulse is applied on the cavity surface. The numerical method, based upon finite differences, treats the various wave fronts exactly. It is shown that the speeds of the unloading wave fronts are dependent upon the decay rate of the applied pressure. The results for cavity displacement are compared with those obtained from an existing method. Author (TAB)

N70-41523# Grumman Aerospace Corp., Bethpage, N.Y.
STRESS AND DEFLECTION ANALYSIS OF MECHANICALLY FASTENED JOINTS Final Technical Report, 15 Jan. 1969 – 15 Jan. 1970
Harry G. Harris, Irving U. Ojalvo, and Reginald E. Hooson Wright-Patterson AFB, Ohio AFFDL May 1970 288 p refs
(Contract F33615-69-C-1263)
(AD-709221; AFFDL-TR-70-49) Avail: NTIS CSCL 13/5

The report presents analytical techniques for predicting both the linear and nonlinear stresses and deformations of mechanically fastened joints. The idealization used is a set of stacked parallel plates which transfer planar loads among themselves by means of transverse fasteners. The plates are treated by finite element methods of matrix structural analysis in which each element is assumed to be in plane stress for both elastic and plastic stress states. The fasteners, which are treated by short-beam theory, interact with the plates under the assumption that the plates may be represented by an equivalent elastic foundation. Application of the present analytical techniques was made to a variety of problems including: the combined elastic-plastic behavior of plates with unloaded holes, the load-deflection behavior of single-fastener joints, the residual stress distributions in plates with squeeze rivets, the effect of fastener bending and shear deformation on the bearing stress distribution between the fastener and the plate, and the prediction of the fatigue life of typical mechanically fastened joints. In all these cases, comparisons with test results generally gave very good correlation. For the range of parameters studied, the effects of hole clearance and fastener interference and geometric configuration appear to play the dominant roles in determining the stress distribution and hence, the fatigue life of mechanically fastened joints. Author (TAB)

N70-41579* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FOLDABLE CONDUIT Patent
Laurence W. Gertsma and James H. Dunn, inventors (to NASA) Issued 3 Jan. 1967 (Filed 26 Aug. 1963) 4 p Cl. 138-119
(NASA-Case-XLE-00620; US-Patent-3,295,556; US-Patent-Appl-SN-304698) Avail: US Patent Office CSCL 13M

A description is given of a nonpermanent deforming, foldable conduit capable of spring back into a rigid position as a self-erecting structural member. The conduit has a cross sectional contour defined by opposing arcs with substantially equal radii so that when flattened the contour will provide a fairly uniform stress. Each arc has three changes of curvilinear shape with approximately equal radii, and the two elements are fastened at the ends so that the curvilinear ends are in juxtaposition tangentially at the point of fastening. Some of the suggested applications of the conduit include radiators for space power systems, rigid legs for landing vehicles which are coiled up within the vehicle itself before being deployed prior to landing, and for connecting a nuclear reactor propulsion system to a space vehicle but at a distance from the vehicle. N.E.N.

N70-41624# Naval Ship Research and Development Center, Washington, D.C. Dept. of Structural Mechanics.
STRESS ANALYSIS OF THIN ELASTOPLASTIC SHELLS Final Report
Otto Lomacky May 1970 113 p refs
(AD-709446; NSRDC-3295) Avail: NTIS CSCL 13/4

A stress analysis is presented of thin shells, having large deflections and being loaded into the strain-hardening range. Plastic strain incompressibility is assumed. The two governing differential equations in terms of the stress function and the normal displacement are presented in two alternate forms. In the first form corresponding equations of the elastic problem are modified only by adding the integrals of the plastic strains. The alternate form requires that the coefficients of the differential equation operators become dependent on the load, and an iterative process is presented by which the solution can be obtained, starting from the known elastic solution. Utilizing the first form, the analysis is applied to the problem of stress concentration around a circular opening, with and without a reinforced ring in a pressurized spherical shell. Numerical solution is obtained by an iterative procedure, using the finite difference technique for the special case of linearized displacements and deformation theory of plasticity. The speed of convergence decreases with increase in pressure and decrease of strain-hardening coefficient. The procedure required to apply the incremental theory and to include finite displacements is also discussed in detail. Author (TAB)

N70-41626# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
TECHNIQUES FOR TESTING STRUCTURAL SUBASSEMBLAGES WITH BRACED AND UNBRACED COLUMNS. DESIGN OF LATERALLY UNSUPPORTED COLUMNS
Lee C. Lim, Eugene L. Sheninger, Koichiro Yoshida, and Le-Wu Lu Jun. 1970 66 p refs
(Contract N00024-69-C-5381)
(AD-709450; FEL-329.2) Avail: NTIS CSCL 13/13

Techniques and setups for testing full-size non-sway structural subassemblages with laterally braced and unbraced columns are described. The height of the sub-assemblages varied from approximately 20 to 33 feet and the width 20 to 37 feet. The columns were subjected to axial forces applied by a universal testing machine and also bending moments transmitted from the adjoining beams. These beams were loaded by two quarter-point loads through the use of gravity load simulators. Depending on the locations of the beams, the columns in the subassemblage were bent either in single curvature or in double curvature. In-plane deflections of the columns were recorded electronically while the out-of-plane deformations of the unbraced columns were recorded by means of depth gages. Electrical resistance gages were mounted on the beams and columns in a unique arrangement so as to allow various types of strains to be analyzed separately. These strains are: normal strain due to axial force, normal strain due to strong axis bending, normal strain due to weak axis bending, normal strain due to warping of section and St. Venant shearing strain. Experimental behavior and sample test results are also described. Author (TAB)

N70-41644# Washington State Univ., Pullman. Dept. of Physics.
DETERMINATION OF CONSTITUTIVE RELATIONS FROM PLANE WAVE EXPERIMENTS
Richard Fowles Apr. 1970 76 p refs Presented at the 2d Symp. on Characterization of the Dyn. Behavior of Mater. at the ASME Appl. Mech. Western Conf., Albuquerque, N.Mex., 25-27 Aug. 1969
(Contract F44620-67-C-0087; ARPA Order 985-3)
(AD-709736; WSU-SDL-70-01; AFOSR-70-2022TR) Avail: NTIS CSCL 20/11

Recent developments in experimental methods for measuring the characteristics of plane compression waves are reviewed, and analytical methods for inferring constitutive relations from measured wave profiles are discussed. A general method, requiring only pressure or particle velocity measurements, is proposed that is applicable to arbitrary waves in which equilibrium or steady state

may not obtain. A summary of current knowledge of constitutive relations obtained from plane wave experiments is also presented.
Author (TAB)

N70-41713# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
THE TRANSIENT LINEAR ELASTIC RESPONSE ANALYSIS OF COMPLEX THIN SHELLS OF REVOLUTION SUBJECTED TO ARBITRARY EXTERNAL LOADINGS, BY THE FINITE-ELEMENT PROGRAM SABOR5-DRASTIC
James J. Kotanchik, Raffi P. Yeghiayan, Emmett A. Witmer, and Barbara A. Berg Apr. 1970 490 p refs
(Contract F04694-67-C-0039)
(AD-709189; ASRL-TR-146-10; SAMSO-TR-70-206) Avail: NTIS CSCL 16/2

A finite-difference solution procedure has been coupled with the SABOR 5 finite element program to permit predicting the transient response of complex shells of revolution which are subjected to arbitrary transient external mechanical loading. The resulting computer program SABOR5-DRASTIC can be employed to predict the small-deflection linear-elastic transient responses of meridionally-curved, variable thickness, single-layer and/or bonded double-layer branched thin shells of revolution consisting of isotropic or of planar orthotropic material whose principal axes are inclined at an arbitrary angle to the meridional or the circumferential direction. Comparisons with reliable independent predictions have confirmed the accuracy and reliability of the SABOR5-DRASTIC predictions. Included are a FORTRAN IV listing of SABOR5-DRASTIC and example problems together with appropriate input and solution output data to enable the user to check the adaptation of this program to his computer facility.
Author (TAB)

N70-41714# Weidlinger (Paul) Consultants, New York.
STRESS WAVES IN A SOIL-FILLED CYLINDRICAL SHELL Final Report
John Kovarna and Hans H. Bleich Vicksburg, Miss. Army May 1970 109 p refs Sponsored by DASA
Contract DACA39-67-C-0021)
(AD-709726; N-70-2) Avail: NTIS CSCL 13/13

An approximate solution to the problem of transient longitudinal wave propagation in a semi-infinite cylindrical body of elasto-plastic material restrained radially by a stacked-ring shell and subjected to a normal pressure at the end is obtained by a Galerkin technique using the radial coordinate as an expansion parameter. In order to get equations applicable to numerical computations the expansions are truncated to the leading term in each variable. This truncation creates a mathematical problem when elastic and plastic regions occur along the same radial line. A finite-difference scheme is used to solve the differential equations resulting from application and truncation of the Galerkin expansion. A special method for handling the boundary between elastic and plastic regions along the same radial line is developed in conjunction with this numerical solution. Numerical results of the finite-difference scheme are presented for several variations in such parameters as shell stiffness and material constants. For the purpose of evaluating the results of the truncation to the leading term in each expansion, the analogous problem is formulated for a linear inviscid fluid and solved twice, once with a truncation to the first term and once carrying two terms in each expansion. The numerical results are presented for these two solutions so that the change in the solution caused by the truncation can be evaluated.
Author (TAB)

N70-41739# Advisory Group for Aerospace Research and Development, Paris (France).
THE 29TH MEETING OF THE STRUCTURES AND MATERIALS PANEL: SUMMARY RECORD. PART 2: APPENDICES
1969 65 p refs Conf. held at Istanbul, 28 Sep.–8 Oct. 1969
Avail: NTIS

Summaries are reported on research in stress corrosion test standards, flutter phenomena in the F104G aircraft, composite materials, brittle materials design technology, and fractography. See also N70-41740 and N70-41741.
R.B.

N70-41740# Advisory Group for Aerospace Research and Development, Paris (France).
THE 29TH MEETING OF THE STRUCTURES AND MATERIALS PANEL: SUMMARY RECORD
Nov. 1969 97 p Conf. held at Istanbul, 28 Sep.–8 Oct. 1969
Avail: NTIS

Summaries and conclusions of panel meetings on structures and materials are presented. Topics discussed include unsteady aerodynamics, aeroelasticity, brittle and composite materials, stress corrosion, fatigue studies, fracture mechanics of metallic materials, high temperature testing, analysis of refractory metals for impurities, and welding in aerospace environments. See also N70-41739 and N70-41741.
R.B.

N70-41741# Advisory Group for Aerospace Research and Development, Paris (France).
THE 30TH MEETING OF THE STRUCTURES AND MATERIALS PANEL: SUMMARY RECORD
May 1970 139 p refs Conf. at Athens, 5–10 Apr. 1970
Avail: NTIS

A summary is presented of panel meetings on structures and materials, including unsteady aerodynamics, design in brittle materials, composite materials, stress corrosion cracking, electrical conductance of aircraft, acoustic fatigue, fracture mechanics of metallic materials, high temperature testing, and nondestructive inspection methods. See also N70-41739 and N70-41740.
R.B.

N70-41755* National Aeronautics and Space Administration, Washington, D.C.
THE NASTRAN USER'S MANUAL
Caleb W. McCormick, ed. Sep. 1970 812 p refs
(NASA-SP-222) Avail: COSMIC $10.00 CSCL 20K

The NASA structural analysis uses a finite element structural model, wherein the distributed physical properties of a structure are represented by a finite number of structural elements which are interconnected at a finite number of grid points, to which loads are applied and for which displacements are calculated. The procedures for defining and loading a structural model are described, along with the data deck and details for each of the data cards. A general description is given of rigid format procedures, along with specific instructions for the use of each rigid format. The procedures for using the plotting capability are outlined. The rules governing the creation of a direct matrix abstraction program are given, and diagnostic messages are documented and explained.
Author

N70-41756* National Aeronautics and Space Administration, Washington, D.C.
NASTRAN DEMONSTRATION PROBLEM MANUAL
Sep. 1970 134 p
(NASA-SP-224) Avail: COSMIC $3.00 CSCL 20K

The demonstration problems for various analyses are presented. These analyses include the following: static, inertia relief, real eigenvalue, differential stiffness, buckling, and piecewise linear analyses; and direct and modal formulations of complex eigenvalue, frequency response, and transient analyses.
N.E.N.

N70-41760# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
EXPERIMENTS ON RESTRAINED COLUMNS PERMITTED

TO SWAY. STRENGTH OF BEAM-AND-COLUMN SUBASSEMBLAGES IN UNBRACED MULTI-STORY FRAMES
Sung-Woo Kim and J. Hartley Daniels Jun. 1970 82 p refs
(Contract N00024-69-C-5381)
(AD-709452; FEL-346.3) Avail: NTIS CSCL 13/13

Experiments were conducted on full-scale restrained columns permitted to sway in order to study their lateral-load versus sway-deflection behavior with a variable rotational restraint stiffness. These tests also provided experimental verification of some aspects of the sway subassemblage method of analysis. Three restrained columns were tested, simulating the restrained columns in a windward, an interior and a leeward sway subassemblage. The column axial load ratio for all the restrained columns was maintained constant at 0.7. Each test specimen consisted of one column and one or two restraining beams welded to the column. The rotational restraint stiffness of restrained column varied during the test due to the formation of a plastic hinge. The test results show good agreement with the predictions from restrained column theory. Author (TAB)

N70-41761# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
THE STRENGTH AND BEHAVIOR OF LATERALLY UNSUPPORTED COLUMNS. DESIGN OF LATERALLY UNSUPPORTED COLUMNS Progress Report
Lee C. Lim and Le-Wu Lu Jun. 1970 240 p refs
(Contract N00024-69-C-5381)
(AD-709451; FEL-329.5) Avail: NTIS CSCL 13/13

The report is a study of the behavior of laterally unsupported as-rolled steel beam-columns under constant axial load and monotonically increasing strong-axis end moments. The first part presents the theoretical solutions for the occurrence of inelastic lateral-torsional buckling of beam-columns with restraints provided at the ends to resist weak-axis bending and warping of the section. The solutions are based on either the tangent modulus concept or the reduced modulus concept of unloading of the yielded portions. The different degrees of restraints are studied and their beneficial effects are compared with the solutions for pinned-end beam-columns, free to warp and bend about the weak-axis. The theoretical solutions are then compared with the available test results and the CRC interaction formula. In the second part, the same method is extended to solve the buckling problems in continuous beam-columns with warping and weak-axis bending restraints at the joints. Sample numerical results are obtained for three-span continuous beam-columns. They are used to check the accuracy of the method currently recommended by the AISI and the AISC for predicting the buckling strength of an assembly of beams and beam-columns. Author (TAB)

N70-41791# Picatinny Arsenal, Dover, N.J.
NEW CONCEPTS IN THE DESIGN OF STRUCTURES TO RESIST THE EFFECTS OF EXPLOSIVE-TOXIC DETONATIONS
Norval Dobbs (Ammann and Whitney), Michael Dede (Ammann and Whitney), and Richard Rindner May 1970 42 p refs
Presented at Seminar on Disaster Hazards, Houston, Tex., 7–8 Apr. 1970; sponsored in part by Combust. Inst. and IIT Res. Inst.
(AD-706829; PA-TR-4060) Avail: NTIS CSCL 13/13

To insure that full protection is afforded in the event of an explosion, modern day explosive-toxic facilities must be designed to fully contain the explosive output of a detonation. The design procedures necessary to achieve this structural containment are described; additionally, several case studies are discussed in which these structural procedures were tested. These studies include both single- and multi-cell arrangements. This presentation was made at a seminar on Disaster Hazards sponsored by the Central States Section of the Combustion Institute at the Manned Spacecraft Center, Houston, Texas on 7-8 April 1970. Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N70-40412# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
HEAT AND MASS TRANSFER IN AN INCOMPRESSIBLE TURBULENT BOUNDARY LAYER
E. Brundrett, W. B. Nicoll, and A. B. Strong Aug. 1970 30 p refs
(RR-19) Avail: NTIS

The van Driest damped mixing length was extended to account for the effects of mass transfer through a porous plate into a turbulent, two dimensional incompressible boundary layer. The present mixing length is continuous from the wall through to the inner-law region of the flow, and although empirical, it was shown to predict wall shear stress and heat transfer data for a wide range of blowing rates. Author

N70-40433# Aerospace Corp., El Segundo, Calif. Lab. Operations.
EFFECT OF ROUGHNESS ON HEATING AT THE FORWARD SURFACE OF A SPHERE AT MACH 5, JANUARY – SEPTEMBER 1969
Robert L. Varwig 15 Apr. 1970 30 p refs
(Contract F04701-69-C-0066)
(AD-708471; TR-0066(5240-10)-12; SAMSO-TR-70-229) Avail: NTIS CSCL 16/3

Heat transfer rates to the forward surface of a 4-in. diameter sphere were measured at a flow of Mach 5 at Re from 1,300,000 to 2,900,000. The sphere surface varied in roughness in terms of stagnation-point boundary-layer thicknesses from smooth to 12.5 boundary layer thicknesses with the roughness dimension characterized by Nikuradses equivalent sand roughness dimension. For the smooth wall, the boundary layer remained laminar over the Re range. Transition was obtained by the addition of roughness equal to the boundary layer thicknesses; however, the resulting turbulent heating was lower than that predicted by an exact solution of the smooth-wall boundary-layer equations. When the roughness was changed to 2 to 3 boundary layer thicknesses, the peak heating reflected the predictions more closely. In comparison with essentially steady wind-tunnel measurements at equivalent flow conditions, the work yielded generally lower heat-transfer rates for similar roughness dimensions. It is proposed that the different character of the roughness as well as its magnitude could influence the measured heat-transfer rates. Author (TAB)

N70-40535# Technische Hochschule Stuttgart (West Germany).
AN ELECTRICALLY HEATED GRAPHITE HOLLOW CAVITY RADIATOR FOR HIGH TEMPERATURES [EIN ELEKTRISCH GEHEIZTER GRAFIT-HOHLRAUMSTRAHLER FUER HOHE TEMPERATUREN]
Manfred Groll (Ph.D. Thesis) 14 Jan. 1969 73 p refs In GERMAN
Avail: NTIS

Construction and evaluation of a black body graphite cavity radiator for measuring high temperature emission coefficients of solid bodies and for standardizing radiation pyrometers is described. The graphite cavity radiator contains a direct ohmic heating system and its calculated apparent borehold emittance is more than 0.998. A computer program is used to solve general heat transfer problems of the geometry with heat sources and with linear and non-linear boundary conditions on its countours by considering radiation

exchange in a coaxial cylindrical cavity. Measurements on the developed black radiator show that sufficient isothermy of cavity walls is obtained. Transl. by G.G.

N70-40536# Technische Hochschule Stuttgart (West Germany).
ON THE EFFECTS OF CAPILLARY GEOMETRY ON OPTIMAL HEATING SURFACE LOADS IN HEAT PIPES [ZUM EINFLUSS DER KAPILLARGEOMETRIE AUF DIE MAXIMALE HEIZFLAECHENBELASTUNG IN WAERMEROHREN]
Konrad Moritz (Ph.D. Thesis) 27 Oct. 1969 107 p refs In German
Avail: NTIS

Possible limitations of energy transfer in heat pipes are studied with fluids of low thermal conductance and boiling retardation. Experiments with several capillary pipe structures indicate that open grooves attain the highest possible surface heat loads. A newly developed heat pipe with threaded arteries obtains high heat loads even at considerable bubble formation in the grooves; gravitational direction does not effect its heat flow; Equations for calculating maximum surface heat loads in open grooves are included and describe temperature as well as pressure effects on heat transfer. Transl. by G.G.

N70-40554 Princeton Univ., N.J.
THEORETICAL STUDIES OF DIFFUSION FLAME STRUCTURES
Cye Harvey Waldman (Ph.D. Thesis) 1969 191 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-18194

The structure of diffusion flames in laminar boundary layers and the one-dimensional unsteady ignition of solid fuels are considered. It was shown that in general the boundary layer exhibits a continuous spectrum of burning from frozen to equilibrium owing to the dependence of the Damkohler number on the downstream coordinate. The near-equilibrium regime was analyzed by the method of matched asymptotic expansions. A detailed discussion of the inner region (flame zone) was given and an explicit expression was obtained for the flame thickness. Higher order outer perturbations were discussed. The higher-order effects of the momentum-energy coupling were examined. Perturbation analysis (for small time) was carried out for cases neglecting and including convective effects by integral and perturbation series methods respectively. Dissert. Abstr.

N70-40581 Stanford Univ., Calif.
NATURAL CONVECTION HEAT TRANSFER IN HOMOGENEOUS AND HETEROGENEOUS REACTING GASES (THE N2O4-NO2-NO-O2 SYSTEM)
Frank Taylor Brown (Ph.D. Thesis) 1969 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-17399

The objective was to determine the effect of several types of reversible chemical reaction on the transport of energy in a natural convection flow regime. The study considered three types of reversible reactions: (1) the equilibrium reaction where the endothermic dissociation reaction was used as the reacting fluid; (2) the nonequilibrium reaction which was modeled by the endothermic dissociation; and (3) the combined nonequilibrium NO2 reaction and a heterogeneous reaction on a platinum surface. An experimental study of the heat transfer from a horizontal cylinder in the reacting fluids was performed. The results in the equilibrium system were analyzed in terms of the dimensionless correlations which were used extensively in correlating data for nonreacting systems. Dissert. Abstr.

N70-40626*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL STUDY OF A CARBON-PHENOLIC ABLATION MATERIAL
Kenneth Sutton Washington Sep. 1970 52 p refs
(NASA-TN-D-5930; L-6455) Avail: NTIS CSCL 11B

The experimental results from a ground-test program are presented for a carbonphenolic heat-shield material designated Narmco 4028. The tests were conducted in supersonic streams of air, nitrogen, and air-nitrogen mixtures at model stagnation pressures from 0.07 to 11 atmospheres and stagnation enthalpies from 1100 to 11000 But/lbm (2.55 to 25.50 MJ/kg). Mechanical char removal of the material did not occur in the nitrogen tests but did occur in air and air-nitrogen mixtures at pressures as low as 2.4 atmospheres depending upon the oxygen mass fraction in the stream. The experimental results were compared with predictions from an ablation computer program. Auth

N70-40637 National Lending Library for Science and Technology, Boston Spa (England).
IGNITION, COMBUSTION AND EXTINCTION TEMPERATURES OF LIQUIDS IN CONTAINERS
E. S. Artemenko et al 8 Jun. 1970 10 p refs Transl. into ENGLISH from Fiz. Goreniya i Vzryva (USSR), no. 3, Dec. 1967 p 542–546
(NLL-SMRE-Trans-5826-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Amyl alcohol was investigated at various levels in quartz tubes. The experiments show that the ignition temperature increases with an increase in distance between the liquid surface and the container rim. The combustion temperature in narrow tubes varies according to a complex principle, but in vessels with a diameter above 50 mm hardly changes during an increase in the distance between the liquid surface and the container rim. If the distance of the liquid surface from the rim of the burner is larger than the limiting value, the heated liquid ignites, but quickly extinguishes itself, but the extinction temperature appears to be slightly lower than the ignition temperaure. R.E.

N70-40660 Carnegie-Mellon Univ., Pittsburgh, Pa.
FORCED CONVECTION FILM BOILING ON A HORIZONTAL SURFACE
Carl David Murphy (Ph.D. Thesis) 1969 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-19102

The heat transfer characteristics of forced convection film boiling on a horizontal plane were studied experimentally. The heat transfer coefficients for boiling benzene, hexane, and methanol were measured at velocities from 3 to 15 ft/sec and temperature differences from 160 F to 452 F. The heat transfer coefficients measured did not agree with the predictive methods which were developed by Zematis and Owens. It was found that the heat transfer coefficient can be predicted with sufficient accuracy for most engineering design by a modified Owens equation. Dissert. Abstr.

N70-40687*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF CHAR FORMATION AND SURFACE RECESSION OF A COMPOSITE ABLATION MATERIAL WITH A SILICONE-RESIN BASE
Allen G. McLain Washington Oct. 1970 42 p refs
(NASA-TN-D-6004; L-6359) Avail: NTIS CSCL 11B

A composite ablation material containing a silicone-resin base, silica fibers, and phenolic and silica hollow microspheres has been subjected to a wide range of test conditions to study its charring behavior. The ablation tests were performed at stagnation point pressures ranging from 0.016 to 1.3 atm and heating rates ranging from 1.34 MW/sq cm to 14.8 MW/sq cm in air and nitrogen. The resulting char-layer surfaces fall into three categories (black char, glassy-coated char, and gray char) as heating rates and char surface temperatures were increased. The char layers formed contained large percentages by weight of silicon dioxide. Silicon

carbide was found to be in chars formed at high heating rates. Empirical correlations of surface recession were determined. For the higher heating rates where stead-state ablation was approached, char-layer constituents and mass loss could be predicted adequately with chemical equilibrium in the reactions at the surface assumed. Author

N70-40729*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DIFFUSION MODEL STUDY IN CHEMICALLY REACTING AIR COUETTE FLOW WITH HYDROGEN INJECTION
Randolph A. Graves, Jr. Washington Oct. 1970 52 p refs
(NASA-TR-R-349; L-6960) Avail: NTIS CSCL 20M

An analytical study of the effects of hydrogen injection and chemical reaction on the flow properties of Couette flow has been conducted. Special emphasis was given to the diffusion model assumed for the calculations. Three diffusion models were chosen for the analysis: Fick's law (binary diffusion), multicomponent diffusion, and an approximation to the multicomponent diffusion. In the Fick's law model, three methods of obtaining the diffusion coefficient were also investigated. Implicit finite-difference numerical solutions to the governing equations for Couette flow were obtained for the three diffusion models over a range of hydrogen injection rates. The results indicate that there are significant differences between the solutions for the diffusion models and these differences are manifested most in the concentration profiles and the wall heating rates. Author

N70-40767# Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
DEVELOPMENT OF LOW COST ABLATIVE MATERIALS
R. C. Laramee, John R. Mathis, and Stanley H. Cardall 1970 36 p refs Presented at 26th JANNAF Solid Propulsion Meeting, Washington, D.C., 14–16 Jul. 1970
(Publ-0370-27016) Avail: NTIS

Development of low cost composite materials as ablative liners in solid rocket nozzle and diffuser designs with 5,700 F and 600 psi gas environments is discussed. Sixty composite material combinations of reinforcements, polymer resins, and fillers were evaluated and characterized in regard to ease of fabrication, laboratory properties, cost effectivity and rocket nozzle performance. The best rated low cost carbon and silica reinforced resin materials applied to a nozzle design range in price from $0.18 to $21.00/lb, while previous standard carbon and silica materials ranged in price from $7.00 to 22.50/lb. Material processing costs were reduced to $1.50 to $17.00/lb with autoclave, vacuum bag, and ambient curing from the standard $20.00 to $25.00/lb hydroclave cure. A study is described in which the 12 best rated materials were applied to a 260 in. diameter 30,000 lb nozzle design. The 260 in. nozzle liner raw material and processing costs were reduced on the average by 72 and 42 percent while only increasing nozzle liner weight by an average 30 percent. Material design tradeoff studies are discussed and indicate the best low cost material to be applied to a particular $25.00/lb hydroclave cure. A study is described in which the 12 best rated materials were applied to a 260 in. diameter 30,000 lb nozzle design. The 260 in. nozzle liner raw material and processing costs were reduced on the average by 72 and 42 percent while only increasing nozzle liner weight by an average 30 percent. Material design tradeoff studies are discussed and indicate the best low cost material to be applied to a particular design problem. Author

N70-40904*# Illinois Univ., Urbana.
RADIANT HEAT EXCHANGE IN A SPACE ENVIRONMENT
Scientific Technical Report, 1 Feb.–31 Jul. 1969
R. G. Hering, A. F. Houchens, T. F. Smith, and W. D. Fischer 31 Jul. 1969 41 p refs Sponsored by NASA Prepared for JPL
(Contract JPL-951661)
(NASA-CR-113580; STR-5) Avail: NTIS CSCL 20M

Analytical methods are being developed for predicting radiant heat transfer and temperature of engineering surfaces in a space environment. By thoroughly investigating the influence of directional and spectral property dependencies of engineering materials on radiant heat transfer and temperature by means of detailed analysis, the accuracy of present calculation methods may be assessed, improved methods may be developed, and the surface property data required to implement these methods may be delineated. A facility is under development to measure bidirectional reflectance of surfaces with the aim of justifying and refining a bidirectional reflectance model for metallic engineering surfaces. Analytical efforts to establish realistic radiation property models for engineering surfaces are discussed, as well as measurements of bidirectional reflectance in the plane of incidence for representative roughened metal samples. Author

N70-40921 National Lending Library for Science and Technology, Boston Spa (England).
EXPLOSIVE PROPERTIES OF COMBUSTIBLE MIXTURES
A. Voellmy Sep. 1969 21 p refs Transl. into ENGLISH from Schweiz. Bauzeitung (West Ger.), v. 86, no. 46, 1968 p 805–811
(NLL-LB-G-2881-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The causes, effects, and properties of combustionable explosions are reviewed. Pure air blasts are discussed as well as those involving liquids, solid fuels, and oxidizing materials. The review is to serve as a set of model laws for the transfer and evaluation of experience and data from other sources. E.H.W.

N70-40935# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF NUCLEATE BOILING FROM MESH COVERED SURFACES
Francis Carl Gregory (M.S. Thesis) Jun. 1970 64 p refs
(AD-709097) Avail: NTIS CSCL 20/13

A boiler apparatus, designed to simulate heat pipe operation, was built and used to investigate nucleate boiling at atmospheric pressure from mesh covered surfaces using distilled water as the working fluid. The wick materials used included 50 mesh, 80 mesh, and 150 mesh nickel screen; 100 count Lektromesh, a one-piece electrodeposited metallic-sheet material; and 30-40 mesh glass beads. Various wick compositions and water levels were investigated. Vapor bubble migrations within the wick material influenced the performance of the apparatus. Providing a means for vapor escape improved the performance considerably. As a result, performance could be improved by using wick materials having larger mesh openings. Sintering screen samples to the boiler surface to reduce contact resistance did not improve performance. Author (TAB)

N70-40981*# California Univ., Berkeley.
INVESTIGATION OF RADIATION AND CONDUCTION OF SOLIDS FOR SPACECRAFT HEAT TRANSFER APPLICATIONS Final Report, 1 Jun. 1968–31 Jul. 1970
C. L. Tien 31 Aug. 1970 6 p refs
(Grant NGR-05-003-285)
(NASA-CR-113794) Avail: NTIS CSCL 11G

Specific subjects under the present investigation are: (1) total emittance of low emittance materials in the temperature range of 300 deg K greater than T greater than 40 deg K; (2) radiation tunneling effect on heat transfer across two closely spaced metallic surfaces; and (3) lateral heat transfer characteristics of multilayer insulations with or without spacers. Author

N70-41021# Naval Postgraduate School, Monterey, Calif.
A STUDY OF WIRE MESH WICK CHARACTERISTICS IN A LONGITUDINAL HEAT PIPE
Oscar Jonathan Hickox, Jr. (M.S. Thesis) Dec. 1969 71 p refs
(AD-709108) Avail: NTIS CSCL 13/1

An everted, glass-enclosed, nickel heat pipe was operated at constant volume using a nickel wire mesh wick and distilled

water. The performance of the pipe was evaluated under various combinations of wick parameters. The effect of the radial evaporator capillary radius, the radial condenser capillary radius, and the evaporator wetting angle were investigated at a pressure range of 27 to 24 inches of Mercury vacuum. The performance of the pipe was found to improve with decreasing radial evaporator capillary radius and decreasing amounts of non-condensables in the working fluid. A detrimental wick-aging effect which led to violent boiling and early dryout was observed. A discussion of observed behavior presents evidence that boiling and wick fin effect may play a significant part in heat pipe operation. Author (TAB)

N70-41135# Technische Hochschule Aachen (West Germany). Inst. fuer Mechanik.
REACTION LAYERS ATTACHED TO SHOCKS Final Report
F. Schultz-Grunow Apr. 1970 58 p refs
(Contract F61052-68-C-0023)
(AD-709685; ARL-70-0095) Avail: NTIS CSCL 19/4

In experiments on the propagation of detonation fronts in gas columns one finds very regular undulations. The report explains the phenomenon by an interaction of shock branching with the combustion. The Mach stems trigger local intermittent reactions which cause again Mach stems. A self sustaining mechanism for Mach stems generation is put forward: The Mach stems trigger local, intermittent reactions which again cause Mach stems. This recurring process yields the propagation of the detonation front. The instant reactions are arranged in a surface with minimum distance which are controlled by diffusion and reaction time. The Chapman Jouguet theory therefore remains valid in the average. This concept is described in detail and substantiated on the basis of experiments arrived at with streak records, still photographs and with the soot method. The theory seems to give a satisfactory explanation of the experimental findings. Author (TAB)

N70-41158*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
HEAT-TRANSFER RATE AND PRESSURE MEASUREMENTS OBTAINED DURING APOLLO ORBITAL ENTRIES
Dorothy B. Lee, John J. Bertin, and Winston D. Goodrich Washington Oct. 1970 89 p refs
(NASA-TN-D-6028; S-159) Avail: NTIS CSCL 20M

Measurements of local pressures and heating rates were made on the Apollo command module during entry from oribital velocities at Mach numbers from 28.6 to 11.5 on Apollo mission 1 and from 31.2 to 2.2 on Apollo mission 3. Flight pressure measurements were found to compare well with wind-tunnel results. Comparisons showed that laminar and turbulent heat transfer theories augmented by wind tunnel data can be used to predict the heating rates to the conical section of the spacecraft. Analysis of the heat transfer rate measurements indicated that transition to turbulent flow occurred on the conical section at local Reynolds numbers between 20,000 and 102,000, based on distance from the stagnation point. No valid heat transfer data were obtained on the blunt entry face. Author

N70-41196# Virginia Polytechnic Inst., Blacksburg. Dept. of Engineering Mechanics.
SURFACE CONDITIONS IN SLIP-FLOW WITH MASS TRANSFER
R. E. Whitehead and R. T. Davis Dec. 1969 26 p refs
Supported by Sandia Corp., Albuquerque, N.Mex.
(VPI-E-69-11) Avail: NTIS

The slip flow boundary conditions for low Reynolds number flow with mass transport are derived using kinetic theory for a slightly non-Maxwellian velocity distribution. The boundary conditions are expanded and simplified for both small and large injection velocities. The continuum stress and heat transfer conditions at a surface in slip flow with mass injection are found and written in terms of the slip flow boundary conditions. The boundary conditions for second-order boundary-layer theory are found for the injection case using the expressions derived. The surface conditions are also used for the viscous shock-layer problem with mass injection. Author

N70-41260# Technische Univ., Berlin (West Germany). Fakultaet fuer Bergbau und Huettenwesen.
MODEL RESEARCH ON A BLAST FURNACE WITH EXTERNAL COMBUSTION CHAMBER AND COMPARISON WITH OPERATING MEASUREMENTS [MODELLUNTERSUCHUNGEN AN EINEM WINDERHITZER MIT AUSSENSTEHENDEM BRENNSCHACHT UND VERGLEICH DER ERGEBNISSE MIT BETRIEBSMESSUNGEN]
Arnd Kappelmayer (Ph.D. Thesis) 1968 115 p refs In GERMAN
Avail: NTIS

The design, development, and characteristics of a model of a blast furnace with an external combustion chamber is described. The thermodynamic properties of the model are compared with operational results. Transl. by P.N.F.

N70-41289# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Fluid Mechanics Section.
COMPUTATION OF FAR FIELD VACUUM PLUME IMPINGEMENT FORCES ON FLAT SURFACES. PART 1: ANALYSIS
J. Brook Aug. 1970 33 p refs
(RM-486-Pt-1) Avail: NTIS

The analysis underlying an IBM 360 program to compute far field plume impingement forces and moments is presented. The plume is represented as a point source having radial streamlines. Each surface is taken to be a flat quadri-lateral, arbitrarily oriented relative to a fixed coordinate system. Mutual shadowing between the various surfaces is computed on a line-of-sight basis. The local pressure and shear stress is computed by using one of five possible gas-surface interaction models assuming free molecular flow. Author

N70-41369# Bureau of Mines, Pittsburgh, Pa. Safety Research Center.
RESEARCH AND TECHNOLOGIC WORK ON EXPLOSIVES, EXPLOSIONS, AND FLAMES, FY 1969
Oct. 1970 32 p refs
(BM-IC-8492) Avail: Issuing Activity

The principal activities of the Explosives Research Center are summarized. Two main programs are reported with emphasis on safety practices in coal mining. These are the explosion, flames and combustion research, and the evaluation of explosives. Abstracts of published articles are included. F.O.S.

N70-41522# Sheffield Univ. (England). Dept. of Chemical Engineering and Fuel Technology.
FUNDAMENTAL ASPECTS OF SUPERSONIC COMBUSTION Final Scientific Report, Mar. 1969 - Mar. 1970
J. Swithenbank and M. Jaques Jun. 1970 8 p refs
(Grant AF-EOAR-69-0050)
(AD-709222; AFOSR-70-1934TR) Avail: NTIS CSCL 21/2

The application of turbulence theory to the design of supersonic combustors has been investigated both experimentally and theoretically. Experimental studies carried out in the 150 mm shock tunnel have shown that a vortex fuel injector can release the heat extremely rapidly (about 200mm) at a stream velocity of about 3000 m/s. A rapidly responding sampling probe suitable for monitoring gas composition variations with 1/4 millisec. has also been developed. The theoretical studies have led to the prediction of an important limitation on the performance of supersonic burners due to the fundamental requirement to produce turbulent kinetic energy at the expense of stream energy. Author (TAB)

N70-41524*# Westinghouse Electric Corp., Pittsburgh, Pa.
HEAT TRANSFER DEVICE Patent Application
Ralph W. Kalkbrenner, inventor (to NASA) Filed 21 May 1970 13 p Sponsored by NASA
(NASA-Case-NPO-11120; US-Patent-Appl-SN-39343) Avail: NTIS CSCL 20M

A heat transfer device characterized by a hermetically sealed tubular housing including a tubular shell terminating in spaced end plates, and a tubular mesh wick concentrically arranged and supported within the housing is described. A feature of the device is an improved wicking restraint formed as an elongated and radially expanded tubular helix concentrically related to the wick. It is adapted to be axially foreshortened and radially expanded into engagement with the wick in response to an axially applied compressive load, by which the wick is continuously supported in a contiguous relationship with the internal surfaces of the shell. NASA

N70-41598# Army Weapons Command, Rock Island, Ill. Research and Engineering Directorate.
FINITE ELEMENT METHOD APPLIED TO TRANSIENT TWO-DIMENSIONAL HEAT TRANSFER WITH CONVECTION AND RADIATION BOUNDARY CONDITIONS Technical Report, 1 Oct. 1969 – 30 Jun. 1970
Rao V. S. Yalamanchili and Shih-Chi Chu Jun. 1970 45 p refs
(AD-709604; AMSWE-RE-70-165) Avail: NTIS CSCL 20/13

The transient two-dimensional heat conduction analysis was prepared by use of a variational principle applicable to linear initial value problems and finite element synthesis. This provided for the use of arbitrary geometry, combination of orthotropic materials, and general boundary conditions. Applicable recent literature was reviewed. Stability and oscillation characteristics of transient two-dimensional heat conduction analysis were established for both finite element and finite difference techniques. The finite difference method was more conservative than the finite element method in both stability and oscillation. Numerical results were computed for several typical gun tube problems with forced convection and thermal radiation boundary conditions. Excellent agreement was obtained with exact solution as well as with explicit and implicit finite difference solutions. Several recommendations have been made to increase accuracy and generality, and to lessen restrictions implied in the techniques. Author (TAB)

N70-41607# Naval Ordnance Lab., White Oak, Md.
THE NOL FOUR-RING THREE PHASE AC ARC HEATER Mk 4 Final Report
Eva M. Winkler, Richard L. Humphrey, and Joseph A. Koenig 13 Jan. 1970 24 p refs
(AD-709440; NOLTR-70-12) Avail: NTIS CSCL 13/1

The design and performance of a four-ring three-phase ac ARC Heater are described. Successful operation at pressures of 10 to 33 atmospheres, temperatures of 2000 to 5000 degrees K and efficiencies of 25 to 60 percent has been demonstrated. Improvements in heater components will allow pressures of 70 atmospheres to be obtained. Author (TAB)

N70-41693# Naval Ship Systems Command, Washington, D.C. Association of Senior Engineers.
DROPWISE CONDENSATION, A HEAT TRANSFER PROCESS FOR THE 1970'S
Clark Graham and Walter F. Aerni 1970 47 p refs
(AD-709390) Avail: NTIS CSCL 13/1

A brief survey of the state of the art for dropwise condensation is presented in order to point out the two principal problems preventing the practical use of this mode of heat transfer in present day condensers. The dropwise condensation heat transfer process, the promoter problem and the non-condensable gas problem are described. The paper covers the space, weight and cost savings, and the other advantages resulting from the utilization of dropwise condensation in condenser design. These estimates are based on marine condenser applications. It is concluded that the payoffs to be obtained in designing for dropwise condensation more than justify continued study in this field. Author (TAB)

N70-41706# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE BELORUSSIAN SSR, NEWS. SERIES IN THE PHYSICAL AND TECHNICAL SCIENCES, NO. 2: SELECTED ARTICLES
B. M. Galitseiskii et al 22 Sep. 1969 33 p refs Transl. into ENGLISH from the book 'Akademiya Navuk BSSR, Vestsi. Seryya Fizika-Tekhnichnykh Navuk, no. 21 1967 p 56 – 76
(AD-702913; FTD-HT-23-235-69) Avail: NTIS CSCL 20/4

Contents: Experimental investigation of nonstationary heat exchange in a tube during variation of the gas flow rate. Experimental investigation of nonstationary heat exchange in a tube during variation of the thermal flux. USGRDR

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N70-40453# Temple Univ., Philadelphia, Pa. Dept. of Mathematics.
LITERATURE ON STATISTICAL DISTRIBUTIONS, A PROPOSAL OF AN INFORMATION RETRIEVAL SYSTEM
Samuel Kotz and Norman L. Johnson (North Carolina Univ.) Jun. 1970 13 p Presented at the Intern. Statistical Inst. Session (37th), London, 3-11 Sep. 1969
(Grant AF-AFOSR-1411-68)
(AD-708521; AFOSR-70-1853TR) Avail: NTIS CSCL 5/2

The paper presents an approach to classifying the literature on statistical distributions. The distribution families and other characteristics of the distributions and papers that were employed in the compilation of a compendium of statistical distributions are listed. Of over 2000 reprints and papers that were collected, 60% were published in 12 basic journals, the remainder being distributed over approximately 240 journals. Approximately 15 minutes were needed by a subject specialist to code each paper. Author (TAB)

N70-40678# Chicago Univ., Ill. Div. of Physical Sciences.
EXPANDED RESEARCH PROGRAM IN MATERIALS SCIENCES Annual Technical Report No. 9, 1 Jul. 1969 – 30 Jun. 1970
30 Jun. 1970 71 p refs
(Contract ARPA SD-89)
(AD-708429) Avail: NTIS CSCL 11/7

The research performed by members of the Materials Sciences Faculty during the period 1969 July 1 to 1970 June 30 is summarized. All publications of each Materials Sciences Faculty member and his colleagues, appearing during this same period, are listed. All the participating graduate students are named and those who have received their financial support from ARPA have been designated. TAB

N70-40720# Air Force Systems Command, Wright-Patterson AFB, Ohio.
DEVELOPMENT PLANNING AND OPERATIONAL CAPABILITIES
F. M. Rogers *In* AGARD Prelim. Design Aspects of Mil. Aircraft Mar. 1970 11 p (See N70-40701 23-02)

Avail: NTIS

The development planning process as a method for identifying, advocating, and obtaining approval for military system and equipment programs needed for new and improved operational capabilities is discussed. The experience of the U.S. Air Force in development planning is used as the example. The changes within the development planning process, the activities, and the tools used in the process are examined. A specific review of the technology plot tool is presented as a means of improving communications among the user (the operational command), the design engineer, and the planner. Development planning evolved as the disciplined process which directs the talents and techniques of operational planners, system analysts, engineers, designers, and technologists toward the goal of providing effective and valid proposals for new systems and equipment for meeting the operational capability needs of the future. Author

N70-40721# Joint Publications Research Service, Washington, D.C.

SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 236

11 Sep. 1970 39 p refs Transl. into ENGLISH from various Sino-Soviet bloc publications

(JPRS-51357) Avail: NTIS

CONTENTS:

1. METEOROLOGY p 1–16 refs (See N70-40722 23-20)
2. OCEANOGRAPHY p 17–20 refs (See N70-40723 23-13)
3. TERRESTRIAL GEOPHYSICS p 21–23 refs (See N70-40724 23-13)
4. UPPER ATMOSPHERE AND SPACE RESEARCH p 24–32 refs (See N70-40725 23-34)

N70-40725# Joint Publications Research Service, Washington, D.C.

UPPER ATMOSPHERE AND SPACE RESEARCH

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 236 11 Sep. 1970 p 24–32 refs (See N70-40721 23-34)

Avail: NTIS

Soviet news releases announced the launching of Cosmos 355 and 356, Intercosmos 3, and Venera 7. Design and functions are briefly described for the thermal channels of narrow angle radiometers for radiation emission measurement onboard satellites. Abstracts of various aerospace and ionospheric literature are also included. J.A.M.

N70-40726# RAND Corp., Santa Monica, Calif.

LEARNING-CURVE TABLES. VOLUME 1: 55-69% SLOPES

H. E. Boren, Jr. and H. G. Campbell Apr. 1970 323 p refs

(Contract F44620-67-C-0045)

(AD-708713; RM-6191-PR-Vol-1) Avail: NTIS CSCL 14/1

The report comprises volume 1 of a three volume series of learning-curve data, including unit curve midpoints for plotting first-lot quantities. Accurate representation of the first-lot quantity is important, because misplacing this point could lead to incorrect conclusions about the cost-quantity relationship. In the past, unit curve midpoints were estimated by various approximation methods because the calculations to obtain tables of true midpoints were complex and laborious. Now, through use of high-speed computers, such calculations can be made quickly and inexpensively. Accordingly, these volumes were prepared to assemble all the information a cost analyst is likely to need in using or plotting learning-curve data. This material was prepared for use in all Air Force cost analysis activities and should also be useful to the other services and the aerospace industry. Author (TAB)

N70-40727# RAND Corp., Santa Monica, Calif.

LEARNING-CURVE TABLES. VOLUME 2: 70-85% SLOPES

H. E. Boren and H. G. Campbell Apr. 1970 326 p

(Contract F44620-67-C-0045)

(AD-708714; RM-6191-PR-Vol-2) Avail: NTIS CSCL 14/1

The report comprises Volume 2 of a three volume series of learning-curve data, including unit curve midpoints for plotting first-lot quantities. Accurate representation of the first-lot quantity is important, because misplacing this point could lead to incorrect conclusions about the cost-quantity relationship. In the past, unit curve midpoints were estimated by various approximation methods because the calculations to obtain tables of true midpoints were complex and laborious. Now, through use of high-speed computers, such calculations can be made quickly and inexpensively. Accordingly, these volumes were prepared to assemble all the information a cost analyst is likely to need in using or plotting learning-curve data. This material was prepared for use in all Air Force cost analysis activities and should also be useful to the other services and the aerospace industry. Author (TAB)

N70-40795# Joint Publications Research Service, Washington, D.C.

SINGLE-SECTOR DYNAMIC MODEL WITH STRUCTURAL IMBALANCE

B. N. Mikhalevskiy 31 Aug. 1970 17 p refs Transl. into ENGLISH from Ekon. i Mat. Metody (Moscow), v. 6, no. 4, 24 Feb. 1970 p 510–520

(JPRS-51276) Avail: NTIS

The objectives of the present article are as follows: (1) to demonstrate qualitatively that the economic-growth equation is a truly a portion of a more general single-sector model with structural imbalance, which, in its turn, is a generalization of the traditional models of general equilibrium for models of that class; (2) to extend the results of the theory of production functions to apply to the case of the three-factor Cobb-Doublas function with variably increasing resources; (3) on this basis to obtain an economic-growth equation with piecewise-constant parameters; and (4) to formulate an equation for a more general family of production functions with structural imbalance. Author

N70-40825# National Bureau of Standards, Washington, D.C. Office of Standard Reference Data.

CRITICAL EVALUATIION OF DATA IN THE PHYSICAL SCIENCES: A STATUS REPORT ON THE NATIONAL STANDARD REFERENCE DATA SYSTEM, JUNE 1970

David R. Lide, Jr., ed. Sep. 1970 77 p refs

(NBS-TN-553) Avail: SOD $0.70 Catalog No. C-13.46:553

Recent activities of the Office of Standard Reference Data are summarized and future plans are indicated. A complete list of data evaluation projects supported by the Office of Standard Reference Data during Fiscal Year 1970 is included. Progress in data processing and in information services is reviewed. The appendix includes a listing of continuing data centers in the United States and a list of publications resulting from the standard reference data program. Author

N70-40826# Joint Publications Research Service, Washington, D.C.

TRANSLATIONS ON EASTERN EUROPE SCIENTIFIC AFFAIRS, NO. 130

9 Sep. 1970 18 p refs Transl. into ENGLISH from various eastern Europe publications

(JPRS-51337) Avail: NTIS

CONTENTS:

1. MICROMINIATURIZATION IN RADIO ELECTRONICS T. Slavov p 4–5 (See N70-40827 23-10)
2. FIRST UNDERWATER RESEARCH VESSEL DESCRIBED

Y. Aleksandrov p 6–7 (See N70-40828 23-13)
3. RADIATION PROTECTION TRAINING DISCUSSED
G. Sitzlack p 8–11 refs (See N70-40829 23-05)

N70-40838*# National Aeronautics and Space Administration, Washington, D.C.
MANAGEMENT: A CONTINUING LITERATURE SURVEY, WITH INDEXES
Jun. 1970 111 p refs
(NASA-SP-7500(04) Avail: NTIS CSCL 05A

A compilation of references to selected unclassified reports and periodical articles on the subject of management is presented. The assembled citations are for material entering the NASA and DoD information systems in 1969. Author

N70-41017# General Accounting Office, Washington, D.C.
ALLOWANCES FOR INDEPENDENT RESEARCH AND DEVELOPMENT COSTS IN NEGOTIATED CONTRACTS: ISSUES AND ALTERNATIVES, DEPARTMENT OF DEFENSE, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, AND ATOMIC ENERGY COMMISSION
16 Feb. 1970 118 p refs
Avail: Issuing Activity

Improved control by the DOD, AEC, and NASA over costs of bidding and related technical efforts charged to government contracts was studied by the GAO in independent research and development programs. Suggestion for establishing a government-wide policy are presented with alternatives and issues. The rights to royalty-free use of inventions under independent research programs, and the differences between the AEC and DOD-NASA policies are discussed. Comments by the Council of Defense and Space Industry Association, and government organizations are included. F.O.S.

N70-41031# Joint Publications Research Service, Washington, D.C.
METHODS OF CONTROLLING LARGE SYSTEMS
V. S. Mikhalevich et al 18 Sep. 1970 13 p Transl. into ENGLISH from Vopr. Filosofii (Moscow), no. 7, 1970 p 54–63
(JPRS-51406) Avail: NTIS

Solution of the problem of complexity in modern cybernetics is discussed with reference to control of large multicomponent systems, such as biological and social structures. Automated control with the utilization of high speed computer equipment, simulation as a method of overcoming complexity, operations research to describe the system through an analysis of its separate elements, heuristic programming, and procedures based on the breakdown approach are among the methods discussed. P.A.B.

N70-41143# Aeronautical Center, Oklahoma City, Okla.
AVIATION TECHNICAL ASSISTANCE TO PANAMA, MARCH/OCTOBER 1969
[1970] 44 p ref
(AC-70-3188) Avail: NTIS

The observations and recommendations of the advisory team arranged by the USAID Mission to Panama to aid in refining Panama's Directorate of Civil Aeronautics are presented. The statutory and budgetary background of the Directorate is investigated, including the basic Panamanian aviation law, air travel tax versus airport service charge, and airport fees. The organization of the Directorate is discussed with reference to its advisory board, statistical services, and office procedures and practices. Aviation safety responsibility recommendations relate to licensing procedures, the flight crew, ground crew, the aircraft, air traffic services, airways improvements, facilities maintenance, and airports. Suggestions are also made regarding programs for increasing tourism, travel statistics amplification, and measures to assist economic regulation of air routes and services. P.A.B.

N70-41151# Federal Aviation Administration, Washington, D.C. Office of Aviation Economics.
NORTHEAST CORRIDOR AIR TRAFFIC AND HIGH SPEED GROUND TRANSPORTATION
Mar. 1970 37 p refs
(AD-705088) Avail: NTIS CSCL 1/2

The high speed ground transportation program is reviewed, and the impact high speed rail passenger service may have on air traffic in the Northeast Corridor is studied. Preliminary high speed rail demonstration programs are being operated in the Boston-New York-Washington markets. In the first year of operation, almost 605,000 passengers used the Metroliner for all city pairs along the New York-Washington route. Business grew steadily throughout the year. The Metroliner had a stimulating effect on total rail passenger volume in the Washington-New York corridor, while total air passenger volume in the same corridor flattened out in 1969 at the 1968 level. Department of Transportation surveys of New York-Washington Metroliner and airline passengers during 1969 indicate strong similarities in such socio-economic characteristics as income, age, and purpose of trip. Author

N70-41155# Federal Aviation Administration, Washington, D.C. Library Services Div.
TRANSPORTATION FOR THE HANDICAPPED: SELECTED REFERENCES, 1960–1969
Lucile E. Beaver, comp. Nov. 1969 30 p refs *Its* Bibliog. List No. 1
(AD-698292) Avail: NTIS CSCL 5/11

The bibliography is arranged in subject categories with indexes for individuals and organizations. The subject categories include: general, personal experiences, government activities, accessibility of travel facilities, air travel, automobiles, special equipment, and transportation for blind persons. P.A.B.

N70-41226# National Research Council of Canada, Ottawa.
THE PROBLEM OF FUTURE TIME SCALES [ZUM PROBLEM KUENFTIGER ZEITSKALEN]
G. Becker 1970 13 p refs Transl. into ENGLISH from PTB Mitt. (West Ger.), v. 6, 1969 p 441–446
(NRC-TT-1420) Avail: NTIS

Time scales are discussed in terms of the various international requirements for standardization. The time scales currently in use are presented with the differences in the application of time in metrology and astronomy. Universal time and atomic time are compared. Some suggestions for obtaining an international time scale are presented. F.O.S.

N70-41227# National Transportation Safety Board, Washington, D.C.
NATIONAL TRANSPORTATION SAFETY BOARD: ANNUAL REPORT TO CONGRESS, 1969
15 Apr. 1970 99 p
Avail: SOD $0.50

The annual report to congress on the activities of the National Transportation Safety Board is presented. Investigations, public hearings, and safety recommendations for both air and surface transportation are included. F.O.S.

N70-41242*# Alabama Univ., Huntsville.
HUNTSVILLE AIR TRAFFIC FORECAST
David G. Mishkin [May 1970] 39 p
(Grant NGL-01-002-001)
(NASA-CR-113917) Avail: NTIS CSCL 05C

The results are presented of a survey of Huntsville commercial air traffic based on published reports of the Civil Aeronautics Board, the Federal Aviation Agency, and the Air Transport Association of America. Contained in the report is a sample of Huntsville air traffic that was obtained in May, 1970, in order to generate additional data. The study was undertaken to better understand the characteristics

of Huntsville's pattern of commercial air traffic in order that future passenger requirements and service improvements may be better evaluated. This report is limited to passenger traffic and ancillary market characteristics. Author

N70-41291# Federal Aviation Administration, Washington, D.C. Office of Aviation Economics.
AIR TRAFFIC FORECASTS: LARGE AND MEDIUM HUBS, AIR CARRIER AIRPORTS
Feb. 1970 14 p refs
Avail: NTIS

The study includes forecasts for 26 large hub airports and 36 medium hub airports. Their significance in the total national traffic pattern is revealed by the fact that in FY 1968 these 62 airports accounted for 72.4 percent of the air carrier aircraft operations; 39.0 percent of total itinerant operations, 29.3 percent of total aircraft operations, and 59.7 percent of instrument operations reported by the 318 FAA air traffic control towers in the United States. The data on air carrier passengers enplaned cover all passengers enplaned at these airports by U.S. as well as foreign flag air carriers. Base data on U.S. certificated route air carriers were obtained from joint FAA/CAB reports. In the absence of reported data, it was necessary to develop estimates of passenger enplanements for foreign flag, supplemental, and intra-state air carriers from other sources such as airport managers, state aviation commissions, and published flight schedules. Author

N70-41307# Federal Aviation Administration, Washington, D.C. Library Services Div.
HIJACKING: SELECTED REFERENCES, 1961-1969
Ann O'Brien, comp. Jun. 1969 23 p refs *Its* Bibliog. List No. 18
(AD-688766) Avail: NTIS

This selected annotated bibliography was compiled to assist individuals working on the problem of aircraft hijackings. Author

N70-41336# George Washington Univ., Washington, D.C. Dept. of Medical and Public Affairs.
A STUDY OF RESOURCES AND MAJOR SUBJECT HOLDINGS AVAILABLE IN US FEDERAL LIBRARIES MAINTAINING EXTENSIVE OR UNIQUE COLLECTIONS OF RESEARCH MATERIALS Final Report
Mildred Benton Sep. 1970 676 p
(Contract OEC-0-8080310-3742(095)) Avail: Issuing Activity

Selected special libraries were represented in an attempt to study the resources and major subject holdings available in U.S. Federal libraries maintaining extensive or unique collections of research materials. The objectives were twofold: (1) to determine the nature and availability of the various collections; and (2) to provide access to subject coverage through both alphabetical listing and a class arrangement. Objectives were fulfilled through presentation of computer prepared tables which identify the libraries involved and which interpret and compare in hierarchial arrangement the data obtained in a systematic fashion. Also provided is a list, in alphabetical order, of the subjects reported by and available in the libraries studied. Author

N70-41368# General Accounting Office, Washington, D.C.
MANAGEMENT OF FEDERALLY FINANCED RESEARCH BY THE UNIVERSITY OF MICHIGAN, A CASE STUDY: B-117219 Report to the Congress
Elmer B. Staats 25 Sep. 1970 129 p refs
Avail: Issuing Activity

The management of research supported by the Federal Government was studied at the University of Michigan by the GAO. Among the findings are the following: (1) The usable space in the university's physical structures devoted to research nearly equaled that used for instruction. (2) A large part of $90.5 million worth of university-owned equipment and $22.5 million worth of government-owned equipment was used for research. (3) Of 21,400 people, 8,000 worked full- or part-time directly on research: 800 teaching faculty, 1,300 research personnel, 2,400 nonacademic personnel, and 3,500 graduate and undergraduate students. (4) In general, the university's management of federally financed research was in harmony with the management needs of the university and the requirements prescribed by the Federal agencies. (5) The time lag between the payment of project costs and the reimbursement by the Federal agencies requires the university to use about $3.6 million of its own funds monthly. It is recommended that the feasibility of adopting a uniform system of providing universities with sufficient advanced funds for programs financed by all agencies be studied. F.O.S.

N70-41392# Congress. House. Committee on Aeronautical and Space Sciences.
NASA AUTHORIZATION FOR FISCAL YEAR 1971
Washington GPO 1970 14 p Presented by the Comm. of Conf., 91st Congr., 2d Sess., 15 Jun. 1970
(Rept-91-1189) Avail: US Capitol, House Document Room

The recommendations by the committee of the conference on the amendment of the Senate bill to authorize appropriation to NASA for research and development, and for facilities are reported. The programs, the amount for each, and the limitations on the use of the funds are listed. The statements of the house managers are included. F.O.S.

N70-41394# Civil Aeronautics Board, Washington, D.C.
REMARKS BY THE HONORABLE SECOR D. BROWNE, CHAIRMAN, CIVIL AERONAUTICS BOARD, BEFORE THE SOCIETY OF AUTOMOTIVE ENGINEERS' AIR TRANSPORTATION LUNCHEON
Secor D. Browne 22 Apr. 1970 4 p Conf. held in New York, 22 Apr. 1970
Avail: NTIS

Problems that must be resolved for the air transport industry to meet the challenges and opportunities from 1970 to 1975 are discussed. Some of the problems and questions are: (1) air pollution and the economic impact of environmental programs, (2) air traffic control, and (3) airport capacity. F.O.S.

N70-41436# Select Committee on Small Business (U.S. Senate).
TECHNOLOGY, TRANSFER, PART 1
Washington GPO 1970 267 p refs Hearings before Select Comm. on Small Business, 91st Congr., 2d Sess., 10 Feb. 1970
Avail: Subcomm. on Sci. and Technol.

Technology transfer programs from space, defense, and atomic energy and their effects on small business are reviewed. A coherent national policy aimed at deriving maximum social and economic benefits from federally supported research and development program transfers is advocated and must involve a policy for small high technology business and entrepreneurship. G.G.

N70-41437# Civil Aeronautics Board, Washington, D.C.
REMARKS OF JOHN G. ADAMS, MEMBER, CIVIL AERONAUTICS BOARD BEFORE THE ASSOCIATION OF LOCAL TRANSPORT AIRLINES SPRING QUARTERLY REGIONAL MEETING
John G. Adams 1 May 1970 9 p Conf. held at New Orleans, 1 May 1970
Avail: NTIS

Changing patterns of commercial air service in the near future and their impact on airline economics are outlined. Air services to a large number of towns are uneconomical and require a federal subsidy program. Subcontracting of small aircraft for massive substitution of services over traffic loss segments provides a suitable feeder service to small towns and relieves the burden on large airline companies. G.G.

N70-41438# Civil Aeronautics Board, Washington, D.C.
REMARKS BY THE HONORABLE SECOR D. BROWNE, CHAIRMAN, CIVIL AERONAUTICS BOARD, TO METROPOLITAN BOARD OF TRADE AVIATION COMMITTEE
Secor D. Browne 9 Apr. 1970 3 p Conf. held at Washington, D.C., 9 Apr. 1970
Avail: NTIS

The chairman of the Civil Aeronautics Board discussed the air transport problem in the Washington, D.C. area. The need for helicopter inter-airport services is outlined and the critical issue of the air traffic controller strike with its economic losses is discussed briefly. G.G.

N70-41475# President's Space Task Group, Washington, D.C.
THE POST-APOLLO SPACE PROGRAM: DIRECTIONS FOR THE FUTURE
Sep. 1969 34 p
Avail: Issuing Activity

The views of the Space Task Group on the Nation's future space programs are summarized for the post-Apollo period. A balanced space program with international participation and cooperation is proposed, and DOD and NASA options covering a range of resource levels are presented. One of the recommendations is the goal of manned planetary exploration with a manned Mars mission before the end of this century. F.O.S.

N70-41514# Congress. House. Committee on Appropriations.
INDEPENDENT OFFICES AND DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT APPROPRIATION BILL, 1971
Evins Washington GPO 1970 43 p refs Rept. to accompany H.R. 17548 presented by the Comm. on Appropriations at the 91st Congr., 2d Sess., 7 May 1970
(Rept-91-1060) Avail: US Capitol, House Document Room

Recommendations are given on appropriations for sundry independent executive bureaus, boards, commissions, corporations, agencies, offices, and the Department of Housing and Urban Development for the fiscal year ending June 30, 1971. Funds are included for vital emergency preparedness, disaster relief, civil defense functions, and numerous other boards and offices that perform specialized roles. A table summarizes budget estimates and the amounts recommended for all items. E.H.W.

N70-41516# Joint Economic Committee (U.S. Congress).
FEDERAL TRANSPORTATION EXPENDITURE FROM THE SUBCOMMITTEE ON ECONOMY IN GOVERNMENT TOGETHER WITH SEPARATE VIEWS
Washington GPO 1970 31 p refs Presented by the Joint Econ. Comm., 91st Congr., 2d Sess., 17 Aug. 1970
Avail: SOD $0.20

The ability of congress and the executive branch to conduct an effective evaluation of transportation programs is examined, as well as the application of general principles of economic analysis to the Federal aid highway program and the supersonic transport development program. Conclusions are: (1) expenditure decisions by both branches should be more unified; (2) laws for investment analysis should be amended; (3) the executive branch should provide congress with more comprehensive analysis of the social costs and benefits of Federal transportation programs; and (4) Congress should improve its capability for evaluating such information. E.H.W.

N70-41543# Federal Aviation Administration, Washington, D.C.
RESEARCH AND DEVELOPMENT PLANNING REVIEW
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 151 – 153 (See N70-41526 23-02)
Avail: NTIS

Research and development efforts are reviewed in the areas of increased airport/airway capacity, improvements in the national airspace system, the aircraft aspects of aviation safety, and civil aeromedical programs. P.A.B.

N70-41544# Federal Aviation Administration, Washington, D.C.
NATIONAL AVIATION SYSTEM POLICY AND PLAN
In its Natl. Aviation System Planning Rev. Conf. Apr. 1970 p 155 – 158 (See N70-41526 23-02)
Avail: NTIS

Long range planning is reviewed with reference to the national aviation system policy and plan documents. Issues involving flight services, airspace allocation and rules, and airport classification are discussed. Remarks are included on the consultative planning process, specific issue consultative sessions, research and development, and conference planning. Anticipated federal action is described for each issue discussed. P.A.B.

N70-41599# Princeton Univ., N.J. Dept. of Psychology.
THE MEASUREMENT AND DEVELOPMENT OF MANAGEMENT INFORMATION SYSTEMS Final Report
Harold M. Schroder Sep. 1970 24 p refs
(Contract N00014-67-A-0151-0020)
(AD-709412) Avail: NTIS CSCL 5/1

The focus is on the application of information processing variables to the study of management information systems. A management information system is evaluated by: The range of relevant information used in decision-making, the number of different conceptions generated re: informational feedback, and the degree to which alternative perspectives are used in decision-making. In combination, these output measures define the information processing capacity of an organization and are strongly associated with effective decision-making in complex tasks. Author (TAB)

N70-41711# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
[A LISTING OF ALL THE OPERATIONS RESEARCH ACTIVITIES OF THE OPERATIONS RESEARCH CENTER] Annual Report, 1 Jul. 1968 – 30 Jun. 1969
Phillip M. Morse 1970 116 p refs
(Contract DA-31-124-ARO(D)-209)
(AD-709691; AROD-968:60-M) Avail: NTIS CSCL 12/2

The purpose of the report is to gather in a simple manner a listing of all operations research activities with which the Centers staff and students are associated. The report reviews the Centers research and educational activities. A section lists publications and professional activities for the report year. The report contains a brief section dealing with administrative matters. Author (TAB)

N70-41734# Aeronautical Center, Oklahoma City, Okla.
AVIATION TECHNICAL ASSISTANCE TO PANAMA MARCH/OCTOBER 1969 (ANNEXES A THROUGH D)
[1970] 133 p refs
(AC-70-3187) Avail: NTIS

Four departments in the Directorate of Civil Aeronautics are discussed: (1) the Air Safety Department, (2) Air Traffic Department, (3) Airports Department, and (4) Air Transport Department. Within the Air Safety Department, the flight operations division and aircraft maintenance division are described as to mission, job functions and associated reference material, staffing, and training. In the Air Traffic Department, the air traffic service division and communications and navigation aids maintenance division are explained. A plan for the installation of aeronautical telecommunication facilities between the international Tocumen airport and other Panamanian airports is reprinted, including data on the basic operational requirements and basic technical factors. The Airports Department is discussed with reference to mission, organization and staffing, terminal buildings, training, maintenance and construction, and records system. Important airport development

projects are listed. The authorized creation of the Air Transport Department is treated with regard to planned mission; proposed reports, regulations, and laws; present and proposed organization; and international route policy recommendations. P.A.B.

N70-41782# Joint Economic Committee (U.S. Congress).
ECONOMIC ANALYSIS AND THE EFFICIENCY OF GOVERNMENT. PART 4: SUPERSONIC TRANSPORT DEVELOPMENT From the Subcommittee on Economy in Government
Washington GPO 1970 145 p refs Hearings before the Joint Econ. Comm., 91st Congr., 2d Sess., and 11-12 May 1970
Avail: SOD $0.60

Testimony concerning the development of supersonic transports is presented. Cost analysis, potential demand, and financial arrangements for the production of the SST and 747 are discussed. Sonic boom, air pollution, weather changes, and airport noise are considered as well as banning of the Concorde and SST. Economics and national defense implications of the SST are also covered. Correspondence is appended. J.M.

N70-41785*# Indiana Univ. Foundation, Bloomington. Aerospace Research Applications Center.
PILOT PROJECT FOR EXPANSION OF RDC RESOURCES VIA ADDITION OF ENGINEERING INDEX, INCORPORATED FILES Final Report
Joseph Di Salvo, Richard W. Counts, and Daniel J. Goodwin Aug. 1970 67 p
(Contract NASw-1942)
(NASA-CR-113885) Avail: NTIS CSCL 05B

The addition of engineering index files to the information resources available is discussed with reference to five aspects: (1) development of services based on the engineering index resources; (2) extent of use by Aerospace Research Applications Center clients; (3) extent of use by other regional dissemination centers; (4) evaluation of standard interest profiles based on this resource by NASA field center personnel; and (5) computer operations in working with the file. Standard interest profiles developed are presented, along with a brief description of the area covered by each of them. A list of journals covered by the COMPENDEX file is included. P.A.B.

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